JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

SEPTEMBER, 1857.

CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

Practical Views on the Proposed Improvement of the Ohio River. By W. Milnor Roberts, Civil Engineer.

(Continued from page 85.)

If it is so difficult, not to say impracticable, to control the freshets of the Ohio River, how can we, as practical investigators, indulge a hope of regulating the great floods of the Mississippi? Even as high up the river as the City of St. Louis, two hundred miles above the entrance of the Ohio, and *excluding* the area drained by the entire Ohio River and all its branches, there are over *five hundred thousand* square miles of territory drained by the Mississippi and Missouri waters; being *twenty times* the Ohio drainage above Wheeling, which we have hitherto been investigating. How are we to arrest "the turbid waters of the Missouri and Mississippi, and make them to flow forever, with a constant, deep, and limpid stream?"

And how is it with the formidable suggestion, that "reservoirs may eventually be made to hold *all* the annual excess, and make the daily flow almost entirely uniform?"

We have shown the inadequacy of sixteen 50 feet dams for the Ohio River; suppose we add two more on the Monongahela, two on the Big Beaver, two on the Youghiougheny, two on the Kiskiminetas, two on French Creek, two on the Clarion, and one more above Olean on the Allegheny. Each of the two on the Monongahela might contain one-half more than one on the Allegheny, the other eleven would not probably contain an average exceeding three-fourths of one on the Allegheny. These 13 additional large reservoirs, upon a liberal estimate, might contain 70,000,000,000, cubic feet, making for the whole 29

reservoirs, 173,000,000,000 cubic feet, occupying all the main rivers and principal branches. Now, the quantity of water which flowed past Wheeling in 1847, as calculated by Mr. Ellet, was 1,142,258,000,000 cubic feet. All these reservoirs would hold only about *one-sixth* of the drainage of that year. This simple fact of itself should impress us with the magnitude of the undertaking to reduce this immense flow to uniformity, especially when we recollect that a single flood of a few days continuance will fill all these reservoirs.

Mr. Ellet shows, that a flood in March, 1841, the highest part of which was only 32 feet at Wheeling, discharged during *eleven* consecutive days, water enough to have more than filled all these reservoirs, and they would have been two-thirds full, or more, when this flood came. The flow in the month of December, 1847, would have filled these 29 reservoirs 1¼ times; and immediately after, on the top of these overflowing reservoirs, came the flood of January, 1848, which rose to 23 feet on the 3d, and to 26 feet on the 6th. How, under such irregular movements of the river floods, could we exert any useful control? And yet, what have we assumed to be done? We have erected dams of 50 feet height, placed continuously, beginning at Wheeling, and occupying the Ohio, the Allegheny, the Monongahela, and their principal branches; destroying the present navigation of all of them, substituting therefor a navigation composed of 50 feet dams, with some peculiar and novel arrangement of locks! We have assumed all this, and what do we accomplish? We secure a radical improvement of the Ohio River, but is it not at the cost of the destruction of every thing above the point where the improvement begins? Granted, then, that even at this cost the river may be improved, have we advanced one step towards regulating the flow of great floods? Let the accumulated facts herein arrayed, decide.

In another part of Mr. Ellet's paper, is this suggestion: "Yet as all the objections that can possibly be urged against the construction of high dams on these great rivers may be obviated, as already stated, by resorting to the smaller affluents, it will be the aim of the writer to make a *first demonstration* of his plan in localities remote from the leading channels of trade, and where there are no important private interests to be consulted."

If we discard dams of great height on the main rivers on account of difficulties that may be attendant upon their erection, and the anticipated injury to navigation interests above Pittsburgh, resort must, of course, be had to the upper waters, as above indicated. Suppose it possible to find sites for *five hundred* reservoirs, each having the capacity of the present Conemaugh reservoir, (466,000,000 cubic feet,) their united contents would be but 233,000,000,000 cubic feet, or a trifle over *one-fifth* of the quantity which flowed past Wheeling in 1847. And, had all these 500 reservoirs been in use, and entirely empty, on the 22d of January, 1840, they must have been filled to overflowing before the middle of February; and in the latter part of the same month, there was a flood of 36 feet height, to be regulated with every reservoir full! During that single short month, there flowed past Wheeling 307,046,000,000 cubic feet, or about *one-third* more than the aggregate capacity of these 500 reservoirs.

Again, in further exemplification of the particular point under discussion, if it were *possible* to locate reservoirs enough to contain the *entire drainage* of *a year*, such as 1845, when 555,482,000,000 cubic feet passed Wheeling. Another year, 1847, shows greatly more than *double* of that quantity passing the same point of observation; leaving 586,776,000,000 cubic feet unprovided for. Each one of these reservoirs would require the drainage of at least seventeen square miles. Now, let an attempt be made to locate 500 reservoirs, embracing localities each covering 17 square miles; or 250 reservoirs, each covering a locality of 34 square miles of drainage. In either case, practical difficulties will be encountered, greater than Mr. Ellet could have thought of at the time he wrote.

The writer, after investigating the records, with a view to the elucidation of this important feature of Mr. Ellet's plan of controlling great floods, is constrained to adopt the opinion, founded upon those records, that it cannot be practically carried out now, or at any future time.

And further, unless expense, damages, health, and navigation interests above Pittsburgh, be entirely disregarded, there are, it seems to the writer, two things proposed which are *not compatible with each other*. One, a system for maintaining the flow in the Ohio at all times up to 6 feet: the other, to prevent the flow from going materially above a uniform height. In one, we need only reservoirs enough to hold the quantity required to raise it from its low stage to 6 feet; in the other, vast river dams, or numerous reservoirs, (or both,) covering the best part of the country! The chief object in one case, is to *hold the water* back, and in the other to *let it go*. In one case we desire well filled reservoirs, in the other we must have them empty, or partially so, or they can be of no avail.

In the foregoing approximate estimates of quantities of water likely to be held by reservoirs, accuracy could not be expected. They are derived legitimately from such data, aided by experience, as to warrant the opinion that they are not likely to prove grossly erroneous; or sufficiently erroneous to alter the general conclusions. This inquiry is not conducted with the view of establishing any particular theory, but to bring the facts fairly before all. They show, at least, that reservoir sites suitable for such gigantic operations, are not so numerous, or so easily attainable, as the public may have been led to suppose. Reservoirs have become so common in connexion with canals and ordinary sluice navigation on minor rivers, such as the Lehigh, and the smaller tributaries of the Allegheny, that the transition to a much larger scale of operations, appears simple and easy. But what, in extent, are the supplies of water for canals, compared with the quantity contained in the flow of a river like the Ohio, at a regular six feet stage?

As a familiar example, take the old Erie Canal in New York, 365 *miles* long, with 40 feet water surface, 28 feet bottom width, and 4 feet depth. This prism would contain 262,099,920 cubic feet. A single day's supply through the dry season for the Ohio River, upon Mr. Ellet's theory, would fill that prism of 365 miles length, more than 4 *times*. A single one of the 500 smaller reservoirs already described, would fill it, and have 203,900,080 cubic feet to spare. This conveys a more

tangible idea than the mere rehearsal of millions of cubic feet. But pursue the comparison a little further: allow that it would require on these 365 miles, 100 cubic feet per mile per minute, to keep up the loss from evaporation, soakage, and leakage, and that 100 boats per day should be passed through locks of 8 feet lift, with chambers 90 feet long and 15 feet wide: the total daily quantity would be 53,640,000 cubic feet. More than *twenty-one* times this quantity would be used in supplying the Ohio River, as proposed, for one day.

There is another practical consideration, already merely glanced at, which we dare not ignore—namely, the probable effect of such a system of reservoirs as that recommended by Mr. Ellet, upon the health of the country. B. Aycrigg, Esq., a Civil Engineer of superior attainments and judgment, formerly engaged in the service of the State of Pennsylvania, makes this remark in referring to this subject: "there may be water enough and places enough if we disregard expense, and the health in the vicinity of large areas, alternately covered with water and exposed to the sun." Mr. Aycrigg is familiar with this region; he made the surveys for a continuous canal across the Allegheny mountains, and proved conclusively, that by means of reservoirs on the head waters of the Susquehanna and Allegheny, it could be supplied with water. He also had charge of the slackwater improvement on the Allegheny River, which was commenced by the same State, and afterwards abandoned from notions of policy which had no reference to the capabilities of the river. Mr. Aycrigg's opinion was decisively in favor of improving the Allegheny, to a certain extent, by slackwater, with dams of moderate height.

Whilst admitting that a *few* sites for reservoirs can be found not subject to serious objection on the score of health, the writer apprehends that an *extended system* of reservoirs, such as would seem to be necessary in bringing about any practical control of the Ohio River, might destroy the salubrity of large areas of country; and that it might happen, that neither any state nor the general government could sustain it. The writer is acquainted with two instances in the State of Ohio, one on the Sandy and Beaver Canal, and the other on the State Canal of Ohio, where reservoirs were forcibly torn down, and the waters let off by the populace, upon the plea, whether true or false, that they were injurious to the health of the people living around them. Nevertheless, he would not be misunderstood; his own opinion is, that it does not precisely follow, that the construction of a reservoir always endangers the health of the surrounding inhabitants. Something depends upon the character of the reservoir, and the manner of using it. But this point is entitled to grave consideration. We will next take up the subject of *low open dams.*

Low Dams with Open Sluice Ways.

Mr. Haupt, in his pamphlet published in 1855, entitled, "A Consideration of the Plans proposed for the Improvement of the Ohio River," introduces his own plan of low dams, as follows:—

"The case which has been considered is, that of an application of the ordinary slackwater principle, by means of high dams and locks. The

objections to it appear to be numerous and formidable, but not insurmountable, and the importance to the general interests of the country of an uninterrupted navigation, would be sufficient to justify the expenditure if it were quadrupled. A system of low dams, with chutes of very moderate inclination, would be free from the delays of lockage; would oppose less obstruction to floods; would be less expensive in first cost, and less expensive in operation, and would throw but little impediment in the way of the descending coal and lumber trade."

This would be in the main true, if the plan did not require "artificial reservoirs," but as these necessarily constitute part of the plan, and as the erection of artificial reservoirs on the large scale required, is not yet decided to be easily practicable, this statement of conclusions must be received with some allowance for the present.

On the precise plan recommended by Mr. Haupt, there are other and more serious objections.

These low dams are to be without locks, to be open at one end for 200 feet in width left for a channel, with a mound in the river, extending from the end of each dam upward, lengthwise of each pool, forming, as it were, a *canal* on one side of the river. The plan, theoretically, is neatly elaborated; but Mr. Haupt did not pursue it minutely through all its practical bearings. The difficulties inseparable from this peculiar arrangement, have been ably discussed in the paper of Mr. Morris, before mentioned. It would occupy much unnecessary space to repeat the whole of Mr. Morris' argument. The chief and vital objections are, that whilst one side of the river would thus be accommodated with a good ascending navigation for steamers, and a good descending navigation for rafts and arks, the other side of the river would be excluded from all participation, in consequence of the dam, and the mound along each pool, —the dam and mound together forming a *cul de sac*,—and in descending with steamers, even in the channel of such confined width, there would not be room to *round to* for landing. To reach any place above and near to a dam, on the opposite side from the channel, steamers would be forced to double the cape of the mound, whatever number of miles it might be. And secondly, the accumulation of sand and gravel, immediately opposite the mouths of the numerous tributaries pouring across this narrow canal, would obstruct and destroy the usefulness of the channel.

Although this plan requires artificial reservoirs, it would obviously need less aid from such supply, than Mr. Ellet's plan of keeping up the natural river.

A modification of the foregoing plan, dispensing with the mounds, and placing the channel at or near the middle of the stream, relieves it of both of the above serious objections. In this form, it is worthy of careful consideration.

Assuming that the present extreme low water depth on the bar at Wheeling is *one* foot, open dams high enough to raise the water 5 feet above that surface, would afford a six feet navigation, whenever there was water enough to keep the water in the open channel, as high as the level of the dam. A continuous succession of dams of 5 feet lift, having the pools connected with each other by channels or open sluiceways 200

feet wide, if well supplied with water, would make an admirable navigation. The length of the pools would vary according to the natural declivity of the river. On the most rapid portion, between Pittsburgh and Wheeling, they would average seven miles each, and on the more gentle part, below Cincinnati, about 15 miles each. Between Pittsburgh and Evansville, a distance of nearly 800 miles, where the aggregate fall is 379 feet, it would take 75 dams, with pools averaging 10½ miles in length.

In regard to the water supply, it may be safely assumed, that if provision be made for keeping up a flow of 6 feet depth through the sluiceways on that part of the river between Pittsburgh and Wheeling, where the most rapid descent occurs, it will be ample at all points on the river, particularly at the lower end, where the fall is less than half as great per mile.

Compared with the plan of feeding the unobstructed river, what proportion of water will be needed?

Mr. Ellet shows, that to bring the water up from the low stage of one foot to a six feet stage, would require a daily supply of 1,062,000,000 cubic feet. Now, assuming that with 6 feet depth in the open dam, in a channel 200 feet wide, the pools being full, the average velocity for the entire prism may be three miles per hour, the quantity passing every 24 hours would be 456,192,000 cubic feet. Deduct the quantity passing in the low water depth of one foot, 102,000,000 cubic feet, and it leaves 354,190,000 cubic feet per day to be provided, which is but one-third of the quantity necessary on Mr. Ellet's plan.

At first view, this plan of a succession of dams, may appear to be merely a reproduction of the old system of wing dams, used to concentrate water into contracted channels. If the plan were only an *occasional* dam at a ripple, it would be the same principle; but with a regular continuous succession of dams, equal in the aggregate height to the entire fall of the river, it is entirely different, inasmuch as they serve to equalize the fall along the whole stream, and when properly supplied with water, all ripples will be entirely lost sight of. The only object of these dams is to save the expenditure of water.

We find from Mr. Ellet's tables, that 3 feet depth on the bar at Wheeling represents a flow of 400,000,000 cubic feet per day, which corresponds nearly enough for present comparison, with the assumed flow for a 6 feet depth in the sluiceways of the dam.

There can be no doubt that these sluiceways in a river like the Ohio, falling only one foot or less per mile, (averaging under six inches,) formed as suggested, will be easily navigable at any stage of water by ascending steamers and descending craft of every description, not drawing more water than the depth of the channel. Indeed, this plan can be carried out on rivers of even greater declivity. Col. S. H. Long, so well and so favorably known in the public service, in his Report to the Secretary of War, of Sept. 1, 1855, makes some pertinent remarks on this very topic. He says, "Sluice navigation is believed to be practicable, ascending as well as descending, under the following limitations, viz: the width and depth of the channel being sufficient to admit the free passage of a steamer, the ascent may be effected in all cases where the acclivity does not exceed 3 feet per mile. The improvement of the

rapids of the Mississippi is predicated on the feasibility of this postulate. * * * Letart's Falls on the Ohio and numerous other rapids above that point, are known to be navigable on terms less favorable than those above intimated. The Falls at Louisville have been ascended by steamers in medial stages of the river, when the acclivity was even greater than that above intimated."

Mr. Ellet, in his paper, remarks, "A descent of nearly 4 feet per mile is not incompatible with the existence of steamboat navigation, if the supply of water be well maintained; for a steamboat has ascended the Allegheny as far as Olean point; overcoming, in places, a slope of nearly 5 feet per mile."

Now, there is nothing so difficult as any of these, proposed in connexion with these low open dams. At the worst, there could scarcely be a velocity due to more than about two feet per mile fall, to overcome; less than is now daily encountered in the river at many of the ripples.

In Mr. Haupt's investigation of the flow of water, he bases his theory upon an isolated dam; which is different from a succession of dams, beginning at the upper end of the river where the fall is 12 inches per mile, and terminating at the lower end, with an average fall of less than 4 inches per mile. This succession, one dam backing the water against another, operates in two ways: in lessening the velocity of the flow through the sluiceways, and in greatly reducing the quantity of water necessary to keep up a six feet stage in the river. The difference is important, and the reason plain. In the case of an isolated dam, the water flowing freely through the sluiceways into the clear open river, meeting no obstruction, passes on with the velocity due to the declivity; whereas, in the case of a succession of dams, the same body of water which will fill the first pool, will also keep all the pools full.

The entire water of the pool will not move with the velocity due even to the middle portion, which is also retarded to a certain extent. It will present the aspect of a central current gliding through a larger body of comparatively still water. Thus, to express it roundly in figures, we may have a current two hundred feet in width passing at the rate of two miles an hour, whilst there may be 650 feet in width on each side, or 1300 feet in width, moving not over half a mile an hour. A portion, indeed, on the sides, may be back current or eddy water.

Again, if the same declivity of one foot per mile existed on the entire river, the same quantity of water would not quite fill the lower sluiceways of the series; but there are two constant causes obviating this, practically; one being the additional quantity of water entering the Ohio from its lower tributaries; the other its greatly decreased declivity.

These peculiarities in the natural regimen of the stream, may perhaps permit the use of wider sluiceways, and consequently shorter pieces of dams, as we descend the river. This seems to be a fair deduction. And furthermore, it is quite possible that the additional water required for the navigation on the upper portion of the Ohio, between Pittsburgh and Wheeling, on the plan of low open dams, may enable us to dispense with dams below Portsmouth. If not on that part of the river, at least below Louisville, where the declivity is but 2·8 inches per mile. It is expected that the government will soon finish the enlarged and improved

canal at Louisville; in that event, on the latter supposition, the remaining works to be built would all be above the Falls.

It is obvious, that every portion of the river below the lower dam, wherever that might be located, would be *improved* by reason of the additional quantity of water obtained from the artificial reservoirs. This remark will of course apply with still more force to Mr. Ellet's plan, on account of the larger quantity needed at the upper end of the river.

Plan and Cost of a Low Open Dam.

An open dam raising the water only 5 feet from pool to pool, would be very simple, and easily constructed. Some of the dams would be founded on rock, but most of them, probably, on gravel. On gravel foundations, the dam should be composed of a timber crib filled with stone, and sheet-piled on the up stream side. On good rock bottom, a substantial common rubble wall laid in cement should be built. The open space, 200 feet wide, might be covered with heavy paving, 18 inches thick, well clamped together, or, after the river had excavated the space several feet deep, it might be filled with a crib to the level of the bottom of the dam. A very cheap arrangement would ensure security at the shore ends of the dams, in all cases, as the water would not run over them until it was at nearly the same height from the back water of the next pool below. The ends of the dams adjoining the sluices, should be tapered from the height of the dam to the bottom of the sluice; presenting a channel about 225 feet wide at the top, and 175 feet at the bottom. Allowing the average width of the river at a 6 feet stage, to be even as great as 1800 feet, it would require but 1600 feet length of dam at each site, and for 400 feet total fall, 80 dams. My calculations give an estimated cost of about $35,000 for each, including two piers or beacons. The aggregate for the 80 dams is $2,800,000: adding 10 per cent. for the preliminary expenses, superintendence, &c., it makes a total of $3,080,000.

The effect of such low open dams upon the great floods of the Ohio, would be scarcely appreciable. It is not worth serious consideration, much less grave apprehension.

If it can be established beyond question, that this plan, as compared with Mr. Ellet's of keeping up the flow of the unobstructed river, may save two-thirds of the cost of the artificial reservoirs, that fact might lead to its adoption as an economical adjunct to the system of artificial reservoirs, in case they should be deemed preferable to locks and dams.

It is entitled to attention in another point of view, as it is quite evident that the low dams will increase the depth in the channels considerably, even without aid from reservoirs, though in the very lowest stages, they would be of no avail without such aid.

Mr. Haupt's analysis of the flow, founded on Mr. Ellet's paper, led him to the conclusion, that "whenever the quantity of water in the Ohio river would be sufficient to give a depth of 2 feet 8 inches on the bar at Wheeling, there would be sufficient to maintain *six feet* depth of water in an artificial channel 200 feet wide, flowing at the rate of 3·13 feet per second, or 2·1 miles per hour." This was based on its flow through the proposed river canal, running between the mound and the

shore, with an assumed fall of one foot per mile. On the modified plan, the pools being once filled, very little more would be required for the flow through the sluiceways, than would have sufficed for the canal.

Should it appear on future examination, that a complete system of artificial reservoirs on Mr. Ellet's plan, would cost $20,000,000 or more, supposing it to be fairly practicable and allowable, it is pretty clear that the adoption of this modification would effect a great saving. Thus, assuming one-third of $20,000,000 or $6,666,666 as the cost for reservoirs on the modified plan, and adding the approximate estimate of the cost of the 80 dams, would give a total of $9,746,667, and a saving of $10,253,333. These are all, of course, but approximations.

But even this comparison does not present fully the two plans. There are other facts derived from the records of the depths of water kept at Wheeling, of sufficient interest to be here introduced, which have a further bearing upon the question of adopting low open dams, as part of a reservoir system.

The following records of the different stages of water, contains some interesting facts, useful in the present investigation.

Records of Different Stages of Water Periods.

Lowest, or one foot stage.—The absolute lowest stage was in September, 1838, when for four days the water was but $\frac{7}{8}$ths of a foot. In the same year there were twelve days in September, and sixteen days in October, when it was at 1 foot. Total 32 days in 1838.

In 1839 it was not so low as 1 foot.

In 1840 it was at 1 foot in July for two days.

In 1841 it was at 1 foot in September for eleven days.

From 1842 to 1848 inclusive, it was not at 1 foot.

Thus, in eleven years it was as low as one foot for but forty-five days, or an average of four days per annum.

One and a half feet stage.—From 1838 to 1848, inclusive, it was never below 1½ feet before July. In July, 1840, it was below 1½ feet, but only for two days. During the eleven years, it was only eleven days (or one day per annum) below 1½ feet as late as August. The whole number of days for the eleven years when it was below 1½ feet, was 104, or an average of less than ten days per annum; and 66 days, or nearly two-thirds of it, occurred during the month of September.

In 1842, 43, 45, 46, 47, and 48, it was not below 1½ feet. During 1838, for 45 successive days, it was below 1½ feet.

Two feet stage.—During the eleven years it was not below 2 feet before July, or after November.

The total number of days when it was below 2 feet was 188; an average of 17 days per annum; and 62 of them, or about one-third, occurred in one year, 1838; and 55 of them in 1841. There were two years, 1842 and 1845, when it did not fall below 2 feet. The greatest number in one year was 62 days.

Two and three-fourths feet stage.—During the eleven years it was not below 2¾ feet before May, or after November.

The total number of days when it was below 2¾ feet, was 509, or an average of 44 days per annum. There were 99 of the total number in 1838, and 85 in 1841. The least number was 14 days in 1847.

Three feet stage.—During the eleven years it was not below three feet before May, and only for a single day (1838,) after November.

The total number of days when it was below 3 feet was 609, or an average of about 55½ days per annum.

The greatest number was 109 days in 1841; next greatest 104 days in 1838; the least number was 15 days in 1847.

From the foregoing data it may be assumed for a *minimum*, that in each year the depth might be

As low as 1 foot, . .	30 days.
Between 1 and 1½ feet, .	15 "
" 1½ and 2 " .	17 "
" 2 and 2¾ " .	37 "
" 2¾ and 3 " .	10 "
	109 days in all, below 3 feet,

and that during the residue of the year, it will be at or above 3 feet, during which period it would need no artificial supply to maintain 6 feet depth in a 200 feet channel, on the low dam plan.

According to the tables, the natural flow for such season during the 109 days should be about as follows, 17,147,000,000 cubic feet.

The flow due to a 6 feet stage in the natural river for 109 days would be,	126,876,000,000 cubic feet.
From which deducting two-thirds would leave, . . .	42,292,000,000 "
And deducting the natural flow,	17,147,000,000 "
Leaves,	25,145,000,000 "

to be supplied by artificial reservoirs for carrying out the plan with the low dams. This quantity might be obtained by three large reservoirs on the Allegheny, and one on the Monongahela. Or, as equivalent, by 54 reservoirs of the capacity of the Conemaugh reservoir; not including or allowing for any loss from evaporation in passing from the sources of the tributaries to Pittsburgh.

From the records and calculations of Mr. Ellet, it will be seen, that the quantity required to keep up the 6 feet stage in the natural river during these 109 days, was, after deducting the actual natural flow, 109,729,000,000 cubic feet. This is within a trifling fraction of *four times* the quantity required for the low dam plan. The reason why it is so much more is, that the ratio of *deficiency* per day is so much greater.

But this is not all: there are still *other days*, when no artificial supply would be needed on the low dam plan, in which the deficiency for the natural river would be very considerable. Thus, in one year (1845), there were 139 days when the water was at or below 4 feet depth. There were 190 days in 1841, when the water was at or below 5 feet, and 207 days when it was below 6 feet. Taking 1838, when the whole number was,

Below 4 feet, . .	133 days.
" 5 " .	161 "
" 6 " . .	164 "

In round numbers there were 24 days, river to be raised from 3 to 6

feet, 28 days from 4 to 6 feet, and 3 days from 5 to 6 feet; requiring 34,000,000,000 cubic feet to be added to 109,729,000,000 cubic feet, making an aggregate of 143,729,000,000 cubic feet of artificial supply. This would be nearly $5\frac{3}{4}$ times the quantity required on the plan of low dams. If the supply were dependent upon the small class reservoirs, it would require 308 reservoirs for the natural river. But if regulating reservoirs of large capacity should be deemed admissible on the main rivers, the number of small reservoirs would of course be diminished on either plan proportionally.

I proceed to the consideration of the system of locks and dams as proposed for the Ohio River, which the writer finds he is compelled to treat more elaborately than he at first imagined would be necessary, in consequence of the number of objections—some apparently of much weight—which have been brought to bear upon it. The public, particularly those who feel a lively interest in, and desire a proper settlement of, this question, are entitled to something beyond a simple contradiction of allegations, or the expression of a mere opinion respecting these objections. It will be the endeavor of the writer to consider every real objection which has come to his knowledge by experience or otherwise. It will be found that the investigation of the objections will constitute the chief argument in favor of the system.

Locks and Dams.

Slackwater navigation, consisting of locks and dams, is nothing new; but latterly many arguments have been made and numerous objections raised against the introduction of a similar system on the Ohio River. Mr. Haupt remarks in his pamphlet, before quoted, "The opinion is generally entertained that the plan of improvement by the construction of a slackwater navigation, is the only one practicable."

It may be, that this plan having been in use many years in various parts of the country, is more generally *understood;* but public opinion, even in Pittsburgh, a city which suffers more than any other from the irregularites of the navigation, has long been divided respecting the *mode* of improvement that ought to be adopted.

Many yet believe, that the plan of operations carried on for a time by the general government, under the superintendence of Major Sanders, had it been continued, would have answered the purpose; though at the most, he only expected to secure $2\frac{1}{2}$ feet in the channels in a dry season.

Experience has demonstrated, that there is not enough water to render the plan of loose stone wing dams and channel excavations successful, without large additional supplies of water from artificial reservoirs. Even a $2\frac{1}{2}$ feet navigation for several months of the year on this plan could not be obtained without a very heavy expenditure; and such a navigation would not answer the present, much less the prospective demands of commerce; whilst every year it would be more disproportioned to these demands.

A modification of Mr. Haupt's plan combined with Mr. Ellet's plan of artificial reservoirs, would be far superior in every respect. It has been already described and discussed in preceding pages. Neither of

these plans, namely, wing-dams, low dams and chutes, or artificial flow, as proposed by Mr. Ellet, can be perfected without the aid of reservoirs on a scale of considerable magnitude.

In regard to a system of locks and dams, or regular slackwater navigation on the Ohio, it is the firm conviction of the writer that no aid whatever is necessary from artificial reservoirs; and that future examinations will not only confirm this, but show, conclusively, that *at all times* there will be a considerable surplus of water, which may be used for hydraulic purposes.

The opponents of locks and dams assert, that there is not sufficient water for a slackwater navigation, without the aid of artificial reservoirs. This may be called their *first objection*.

To support this objection, but one fact has been presented, and that fact unaccompanied with an explanation which would have destroyed the erroneous impression it conveyed. That fact is, that the Monongahela slackwater in dry seasons is short of water sometimes, and that the Company contemplate the erection of reservoirs on the head waters, in order to make up the deficiency.

Admitting this to be true, let us follow it up with another fact. "In 1838, at the period of the lowest water known in the Monongahela, Allegheny, and Ohio Rivers for a great many years, the flow of water in the Monongahela above Pittsburgh was found to be in round numbers only 12,000 cubic feet per minute, whilst the flow in the Allegheny, as gauged by Major (then Captain) Sanders, was found to be in round numbers, 150,000 cubic feet per minute, or over 12 times the flow of the Monongahela." These rivers form the Ohio, at Pittsburgh, and the two contained at that time 13½ times the quantity shown in the Monongahela. The remarkable difference in the volume of water supplied by these two streams in dry seasons, is so striking and well known that it ought not to have been ignored.*

Now dam No. 1 on the Monongahela just above Pittsburgh is about 1300 feet long and 15 feet high. No greater height is contemplated on the Ohio; and how much greater will be the length of the dams? None of the opponents of slackwater navigation, would willingly estimate the length of each dam, exclusive of the space occupied by the abutment and double locks, at over 1560 feet, or one-fifth more than that on the Monongahela. It has been proposed to fix the height from pool to pool at not exceeding 8 feet; whereas, in dry seasons, on the Monongahela, the lift is 9 feet or more. What are the elements for comparison? We have seen that in an *excessively* dry time, such as occurs once in ten years, —there was at the head of the Ohio at the very commencement of the proposed slackwater, over *thirteen* times as much water as there then was in the Monongahela, its smaller tributary, and upon which has been in operation ever since, the most successful lock and dam navigation in the Union. Were the dams on the Ohio to be of the same height, the leakage and evaporation should be the same per foot of length of dam; but the Ohio dams are to be one-ninth less in height from pool to pool, and one-fifth longer. Whilst there will be one-fifth more length, there

*For some more recent measurements of the quantity of water in the Monogahela in a time of drought, see Appendix.

will be one-ninth less pressure upon every leak. So that practically, the total difference of leakage must necessarily be very trifling.

The number of cubic feet passing at the head of the Ohio, as gauged during the remarkably dry season of 1838, was 233,080,000 cubic feet per 24 hours. The writer has no certain means of determining whether the *average* for the driest month was more or less than this measurement. But we have some testimony which may be regarded as corroborative, from the records at Wheeling, and Mr. Ellet's calculations. On page 53 of his pamphlet he remarks, "But though the Ohio River never ceases to send water to the ocean, it will be seen by reference to note D, in the Appendix, that during *the memorable drought of* 1838, there was a period of 120 consecutive days when the depth on the bar at Wheeling was less than 5 feet. The actual average daily discharge during these 120 days, computed by the formula given in this paper, was about 220,000,000 cubic feet." We have no means of deciding whether the influx from the tributaries between Wheeling and Pittsburgh was greater or less than the evaporation at that particular period. The coincidence in the quantities represented, the one by actual measurements at Pittsburgh, in 1838, and the other by intelligent deductions from measurements in 1849, connected with the recorded depths of 1838, at Wheeling, is rather remarkable than otherwise. The difference being less than six per cent. of the larger quantity. But to make sure, suppose we take an extreme case, and allow only *one-half* of the *smaller* quantity as the basis of a summer daily supply! Would the opponents of slackwater demand harder terms?

Allowing the locks to be 350 feet long and 60 feet wide in the chamber, with 8 feet lift, the quantity for each lockage would be 168,000 cubic feet. Estimating a lockage every five minutes during the 24 hours, there would be 288 lockages, using 48,384,000 cubic feet, which, deducted from the assumed minimum 110,000,000, would leave 61,616,000 cubic feet to supply the *leakage* and *evaporation* of the first pool. This is more than 3½ times the entire flow of the Monongahela as gauged in 1838. And it would be considerably more than the leakage, soakage, and evaporation on 365 miles of the Erie Canal, including 100 lockages per day.

No civil engineer could stand justified in constructing a dam not over 1600 feet long, with no more than 8 feet lift, that should leak to an extent approaching such a body of water. Such leakage would, in *eight days*, exhaust the Conemaugh reservoir, constructed to supply the deficiencies of 104 miles of canal—with numerous dams of *much greater height*, for a whole summer!

Mr. Ellet also remarks, that "During six consecutive years, from 1843 to 1848, inclusive, there was but one month, August, 1843, when the average flow on the Wheeling bar was (a trifle) less than two feet depth, and but two other months, August, 1845, and September, 1848, when the average flow was less than 3 feet." And according to his calculations, with two feet on the bar, the flow was 228,000,000 cubic feet per day, more than double of our assumed basis; and with 3 feet on the bar, 400,000,000 cubic feet, or over 3½ times the same.

With these *facts* for our guidance, is it unreasonable to expect that notwithstanding the Monongahela Company may be forced to resort to artificial aid, the slackwater on the Ohio will be well supplied without any such arrangement? Surely it cannot cost the Monongahela Company much to obtain the little additional water they may need merely for slackwater purposes, if, according to the calculations of Mr. Morris, and Mr. Ellet, it will cost so little to furnish a constant flow of *not less* than 5 feet depth for the broad current of the unobstructed Ohio, flowing freely over its bed on a declivity of one foot per mile; and requiring 864,000,000 cubic feet per day, nearly *eight times* the quantity we have assumed to be *abundant* for the Ohio slackwater!

To controvert successfully, the opinion that there will always be an ample supply of water on the Ohio slackwater, should it ever be constructed, something more than a bare assertion to the contrary, with a mere reference to an inapplicable example, is looked for.

In the present state of the discussion, the writer thinks he will be sustained by the judgment of every candid examiner, in the opinion that this *first objection*, namely, want of water for the lock and dam system, has no reliable foundation. The question of water supply is a very important one, and we have endeavored in this case to put it to a severe test.

(To be Continued.)

For the Journal of the Franklin Institute.

On the Timber Bridges upon the Providence, Hartford, and Fishkill Railroad. By A. F. Wilder, Assistant Engineer.

The timber bridges of long span upon the line of this railroad, are constructed upon Howe's plan, with all the improvements, of which the following extract from the specifications will give a general idea:

"Bridges of less than 60 feet span only, have low trusses. The trusses of *open* and *rafter* bridges are 14 feet apart in clear, and 21 feet high; and of *deck* bridges of a height and distance apart adapted to their locality.

"The following general specification for a bridge of 120 feet span may be deemed a standard: bridges of other spans having at least equal strength. Trusses 21 feet high, 28 inches thick, and 14 feet apart. Panels from 10 to 11 feet long. Bottom chord, two pieces of $5\frac{1}{2}\times13$ inches, and two pieces of $6\frac{1}{2}\times13$ inches. Top chord two pieces of 6×10 inches, and one piece of 12×10 inches. Main braces, one half 8×10 inches, and one half 7×10 inches. Counter braces 7×8 inches. Floor beams, 6×13 inches, four to a panel, with an extra one under joints of track-string. Track-stringers equal in size to 11×12 inches; either single or in two pieces.

Bolts.—First set,	.	two of $1\frac{3}{8}$ inches,	and one of $1\frac{1}{4}$ inches.	
Second set,	.	" $1\frac{1}{4}$	" "	"
Third "	.	" $1\frac{5}{8}$	"	
Fourth and fifth set,		" $1\frac{1}{2}$	"	
Middle,	.	" $1\frac{3}{8}$	"	

"The timber is of the best western white pine, except the wall plates and bolsters, which are of white oak."

In some bridges the floor beams rest upon a false chord, properly supported from beneath, or suspended from above, at a varying distance between the top and bottom chord, depending upon the requirements of the different localities.

The low truss bridges have the trusses covered separately with side boarding and a tin roof, the flooring being left open. Larger bridges have the sides covered with clap boards secured to upright scantling. The ends are cased up, and the side boarding returns into the bridges from 10 to 15 feet at each end as a protection against driving-storms. On *deck* and *half-deck* bridges, the decking is so arranged as to admit the ordinary cross-tie, and obviate the necessity of having the rail spike pass through the tin.

These bridges were built by Messrs. Stone & Harris, of Springfield, Mass., under the direction of the chief engineer.

For bridges of short span, a form of truss has been adopted in many cases like that shown in Plate I. At Riverpoint, the centre line of railroad passes within a few rods of Dr. Harris's large cotton mills, where an embankment of earth or a stone viaduct would have seriously obstructed the light from the factories. A light timber structure was therefore erected, combining these two forms of construction, the roadway and the sluiceways from the factories being spanned by eleven trusses of 35 feet each in length, and the river by a Howe truss of 75 feet span in clear, making in all 467 feet for total length of viaduct, of which 82 feet are of Howe's truss, and 385 feet of the short truss (35 feet).

The general plan of construction for this bridge will be readily understood by reference to Plate I., in which a part only of the river span and three of the short spans are shown, each of which consists of four trusses, the two middle ones underneath the track-string—as will be seen by the specifications for timber—being somewhat heavier and stiffer than the outer ones. The trusses are supported by systems of three trestles resting on each pier, the middle trestle extending up to the track-stringer, and having four posts, the two outer ones being inclined. The outer trestles having two perpendicular posts only underneath the middle trusses, extending up to the lower chord. The track stringers rest immediately upon the thrust-pieces, and the rail lies upon the planking.

The piers are of peculiar form, built with economy of material for the purpose for which they were intended. The middle portion upon which all three trestles rest, is carried up of full thickness (5 feet,) from the foundation, while the ends, of 11 feet in length, are built with three offsets, leaving a width on top of only 22 inches, sufficient to receive the sill of the middle trestle.

This bridge was designed by S. Ashburner, Esq., Chief Engineer, and the details of construction were carried out under the direction of S. B. Cushing, Esq., Division Engineer. The scale of the full view is 20 feet to the inch or $\frac{1}{240}$; that of the section of trusses and view of trestle is 10 feet to the inch or $\frac{1}{120}$. The following bill of timber was used in

the construction of the 385 feet of short truss, amounting to 91,235 feet board measure, together with 17,700 feet 4 inch plank.

Specification of Timber for Trestle Bridge at River Point.

Number of sticks	Description.	Length.	Size in inches.
22	Upright posts, middle trestle of each set,	22 ft.	14×14
22	Inclined " " "	23 ft.	14×14
40	Upright " outer " "	16 ft. 9 in.	12×12
22	Caps, middle " "	15 ft. 6 in.	7×14
20	" outer " "	7 ft. 6 in.	8×12
22	Upper girders, middle " "	17 ft. 3 in.	8×12
22	Lower " " " "	22 ft.	6×12
11	Sills, " " "	29 ft. 6 in.	8×14
20	" outer " "	7 ft. 6 in.	8×12
22	Track stringers,	35 ft.	12×15
44	Outer "	35 ft.	3½×15
44	Corbels,	7 ft. 6 in.	10×12
2	Wall plates,	14 ft. 9 in.	6×12
	FOR TRUSSES.		
22	Inner thrust pieces,	16 ft. 3 in.	12×12
44	Outer " "	16 ft. 3 in.	3½×12
44	Inner braces,	10 ft. 6 in.	12×12
44	" "	8 ft. 9 in.	8×12
88	Outer "	10 ft. 6 in.	3½×12
88	" "	8 ft. 9 in.	3½× 8
22	Inner lower chords,	34 ft.	9×12
44	Outer "	34 ft.	3½× 9

4 in. plank in lengths of 15 feet 3 inches, each. Widths not less than 10, nor more than 12 inches.

Bolts for each Span.

Main truss.	Outside truss.
4 of 1¼-inch.	4 of 1⅛-inch.
2 " 1⅛ "	2 " 1 "

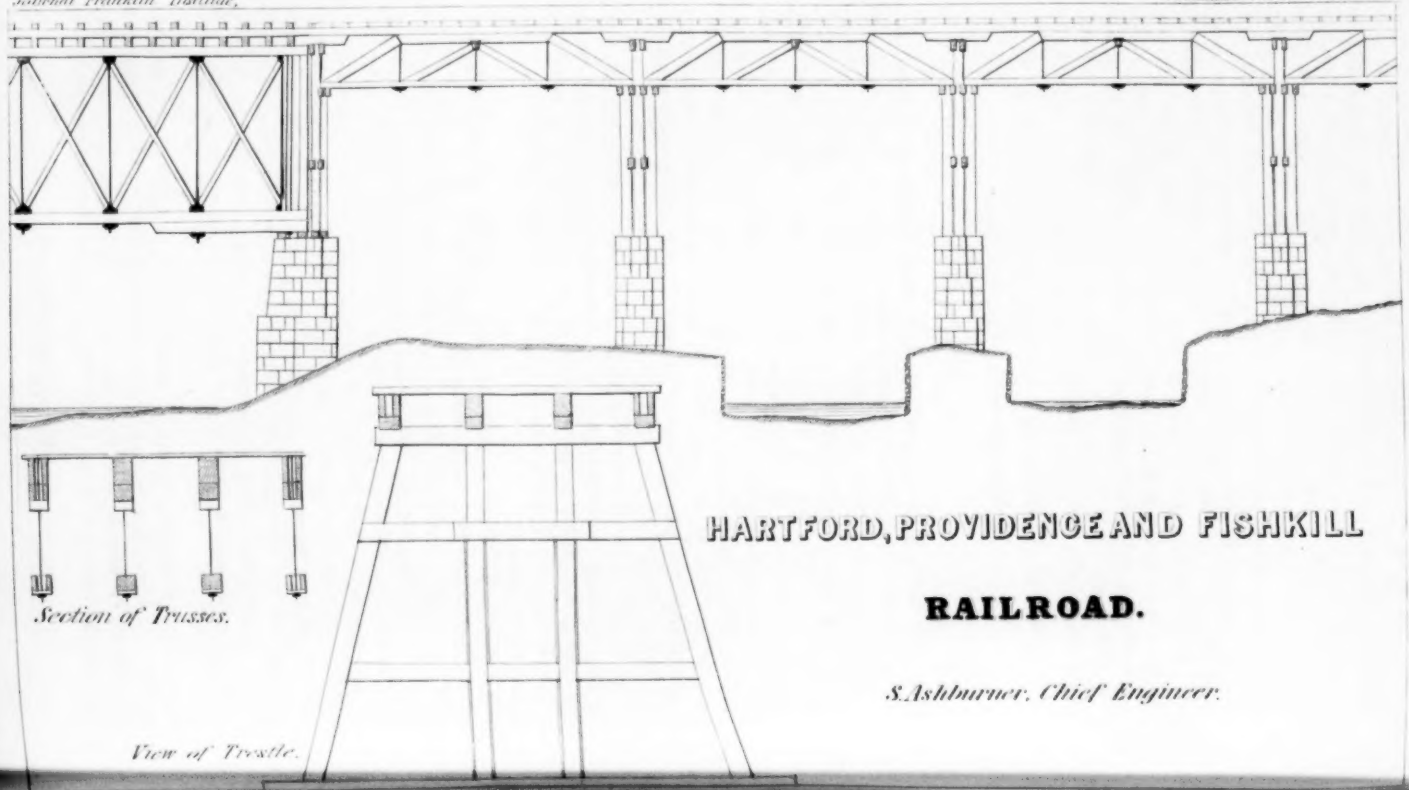
Bolts for caps, girders, and corbels, ¾-inch.

For the Journal of the Franklin Institute.

On the Submarine Telegraph. By A. C. Jones, Engineer.

The connexion of Europe with America by means of the "Ocean Telegraph," will soon be attempted by the laying of the telegraph cable, and if it fails, it most probably will be from the great strain on the wires during the first few miles, when the cable is suspended between the two sterns of the frigates.

Up to the present time, (and I have waited until I believe all the details have been published,) there has been no other precaution against this great strain and consequent stretching of the cable, than the making of about five miles of the wire, of steel instead of iron. This may or may not be sufficient to prevent a rupture of the small copper conducting wires, but it seems to me that where so much is at stake,



Section of Trusses.

View of Trestle.

HARTFORD, PROVIDENCE AND FISHKILL

RAILROAD.

S. Ashburner, Chief Engineer.

other precautions should be taken, and I will suggest one method which involves no change to the cable nor any delay in paying it out, and this is simply to attach *floats* to the cable by cords long enough to allow the cable to sink below the keels of vessels likely to cross its line before its final sinking.

The floats could be either kegs, bags of canvass made air-tight, "carboys," or demijohns well stoppered. To attach these to the cable, the following course should be pursued: a man stands at the "taftrail" on one side of the cable with a float in his hands, its lanyard (having a small hook at its end,) leading to another man near the cable, he passes the end around it, and hooks it to its own part, (making a running bow line,) keeping it loose so that the cable runs through it until the allotted space is reached; a slight pull jambs the cord on the cable, and the float passes from the man holding it to the surface of the sea. On the other side of the cable, two men similarly situated, act in the same manner, and thus a float passes alternately from each side of the cable without confusion or delay.

The cable having the floats to support it at points from the middle, will sink to the length of the float lines, forming a series of undulations, which will produce an elasticity and neutralize the strain on the cable by the pulling of the steamers, and the buoyancy of the floats will relieve it of other strain.

After a sufficient length, commensurate with the depth of the water, has been floated, the floats there may be attached at greater distances apart until no more are required; the effect will now be that the floats not being sufficient to support the cable it *gradually* sinks, and one after the other of the floats are dragged under, until all of the floated portion slowly reaches the bottom of the sea, and then the floats will either become ruptured or filled by the pressure of the column of water.

I was once a witness of a long seine which had been improperly weighted, act in the precise manner which I have pointed out the cable would do, and I give the suggestion to those interested to adopt or not.

For the Journal of the Franklin Institute.

Railroad Developments. By John M. Richardson, B. S.

The maximum grade of any road is determined by the following considerations, viz: the character and amount of the traffic it is required to accommodate, the topography of the country through which it passes, and the funds at the disposal of the company. "What a road ought to be," is determined by the first of the above considerations, but the second and third, frequently, if not always, interfere and determine that it must be what it should not be.* Owing to the great irregularity of the surface of the earth, the ingenuity of the superintending engineer is often severely taxed in endeavoring to keep within the limits of the required grade, and very frequently much valuable time is lost. I propose to present in this paper, some considerations which should influence an engineer when seeking to locate a road between two points, the direct

* See note 1, page 167.

line connecting them being too short. This is a case of frequent occurrence in hilly and mountainous districts, and one which often causes much difficulty. Imagine a case. Suppose it is required to connect two points A and B, whose difference of level is six hundred and sixty (660) feet, their horizontal distance apart ten (10) miles, and the maximum grade forty (40) feet per mile. It is evident that the straight line connecting A and B is too short and steep, for it rises sixty-six (66) feet per mile. Hence the line cannot be straight, but must be curved or mixed. Regard A as the lowest of the points; a little consideration will show that in order to get the shortest line fulfilling the required conditions, it must continue to ascend according to the given grade. Now, $660 \div 40 = 16{\cdot}5$; that is, the horizontal length of the required road is 16·5 miles. If from the nature of the surface between A and B any part of the road connecting them be necessarily level, the entire horizontal length will be 16·5 miles + the level part. If the road any where descends below the regular grade line in passing from A to B, the entire horizontal length will be 16·5 + a length equal to that necessary to overcome a height twice that of the descent. If the road any where ascends above the regular grade line in passing from A to B, the entire horizontal length will be generally equal to at least 16·5 miles + a length equal to that necessary to overcome a height twice as great as the ascent. Thus, if in passing from A to B, the line any where descends one hundred (100) feet below the grade line it will have to ascend the same, and this ascent and descent of an extra one hundred feet will be equivalent to adding at least two hundred (200) feet to the original difference of level; making it eight hundred and sixty (860) feet, and increasing thereby the horizontal length of road by at least five (5) miles. Cases may arise in which it will be impossible to avoid making occasionally such descents and ascents in passing from A to B, but such a location should be given to the road, if it is possible to find one not attended by too great cost, that the ascent from A to B may be gradual and constant.*

If d denote the sum of the unavoidable descents below the grade line in passing from A to B, a, the sum of the unavoidable ascents above the grade line, l, the length of level part, the entire horizontal length of road connecting A and B, will be generally, at least

$$16{\cdot}5 + 0{\cdot}05\,(a + d) + l \text{ miles.}$$

And the length of the road itself,

$$l + \left[\left(\frac{330 + a + d}{2640}\right)^2 + 0{\cdot}0025\,(330 + a + d)^2\right]^{\frac{1}{2}} \text{miles.}$$

If $a = d = l = o$, the length of the shortest line will be, 16·500473 miles.

Now, although this is the *shortest* line fulfilling the required condition, it may assume *several different positions;* it may lie entirely on one side of the vertical plane, passing through A and B; or, partly on one side and partly on the other; or it may assume several different positions on the same side.† Some of these positions or locations, will now be traced and others indicated.

PROBLEM.—Having given the difference of level of two points A and B, and their horizontal distance apart, it is required to connect them by

* See note 2, page 167. † See note 3, page 168.

a line rising uniformly from A to B according to an assumed grade—that is, by a line making a constant angle with the horizon. Let the horizontal plane of reference pass through A, and B′ be the projection of B on that plane; h = height of B above A, and $2c$ = their horizontal distance apart.

Since the required line is to make a constant angle with the horizon, it must be a helix, and if a denote the constant angle, the length of helix is,

$$z = h \operatorname{cosec} a. \quad . \quad . \quad (1)$$

The horizontal projection of z, or horizontal length of line connecting A and B, is,

$$s = z \cos a = h \cot a, \quad . \quad (2)$$

The *length* of a helix as well as the length of its horizontal projection, is unaffected by the nature of the surface upon which it is located, but the *position* of the helix in space, and the form as well as position of the curve into which it is projected, depend entirely upon the nature of this surface. (See article on "Helices and Helicoidal Surfaces," in *Journal of the Franklin Institute*, vol. xxxiii, page 231.)

For the sake of simplicity assume that the helix is located on a right cylinder with circular base, whose projection on the plane of reference passes through A and B′, and that the helix shall not pierce the vertical plane of A and B. The projection of the helix, which will be the horizontal length of the required line, and which is known from difference of level of A and B, and the assumed grade, will be the arc of a circle passing through A and B. The problem will be solved when the radius of this arc and the angle subtended by it are determined.

Fig. 1.

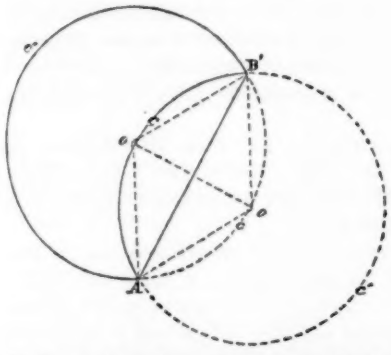
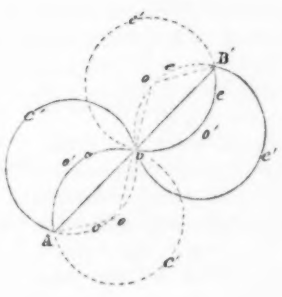


Fig. 2.



Let A C B′ be the projection of the helix: ρ = O A the required radius, 2ϕ the angle subtended by A C B′. The equations of condition are,

$$\rho\, 2\phi = s = h \cot a, \quad . \quad . \quad (3)$$

$$\rho \sin \phi = c, \quad . \quad . \quad (4)$$

Expanding $\sin \phi$ in terms of ϕ,

$$\sin \phi = \phi - 2^{-1}.\, 3^{-1}.\, \phi^3 + 2^{-1}.\, 3^{-1}.\, 4^{-1}.\, 5^{-1}\phi^5 - 2^{-1}.\, 3^{-1}.\, 4^{-1}.\, 5^{-1}.\, 6^{-1}.\, 7^{-1}.\, \phi^7 . + \&c.,$$

Substituting in 4,

$$\rho\,(\phi - 2^{-1}.\, 3^{-1}.\, \phi^3 + 2^{-1}.\, 3^{-1}.\, 4^{-1}.\, 5^{-1}.\, \phi^5 - 2^{-1}.\, 3^{-1}.\, 4^{-1}.\, 5^{-1}.\, 6^{-1}.\, 7^{-1}.\, \phi^7 + \&c.) = c, \quad . \quad . \quad (5)$$

Eliminating ρ between (3) and (5), and taking only these terms of the development of sin ϕ,

$$\phi^4 - 20\phi^2 = 240\, c\, h^{-1} \tan a - 120, \quad . \quad (6)$$

Solving (6),

$$\phi = \pm [10 \pm (240\, c\, h^{-1} \tan a - 20)^{\frac{1}{2}}]^{\frac{1}{2}}, \quad (7)$$

Substituting in (4) and reducing,

$$\rho = d \operatorname{cosec} [10 \pm (240\, c\, h^{-1} \tan a - 20)^{\frac{1}{2}}]^{\frac{1}{2}}, \quad . \quad (8)$$

From (7), it is evident that ϕ will have at least two real values, numerically equal, but affected with contrary signs, when,

$$\tan \overline{\overline{>}} 6^{-1} (2c)^{-1} h, \quad . \quad . \quad (9)$$

If a' be the angle made by the straight line connecting A and B with A B', $\tan a' = (2c)^{-1} h$, and (g) becomes,

$$\tan a \overline{\overline{>}} 6^{-1} \tan a', \quad . \quad . \quad (10)$$

If in addition to the condition expressed by (10) there is this other one, viz:

$$10 \overline{\overline{>}} (240\, c\, h^{-1} \tan a - 20)^{\frac{1}{2}}, \text{ or reducing,}$$

$$\tan a \overline{\overline{<}} \tan a' \quad (11)$$

ϕ will have four values, of which, however, only two will differ numerically.

It is evident from the nature of the problem and the conditions assumed, that tan a can never exceed tan a'; also that the two values of ϕ which differ numerically, must be supplements to each other, *i. e.*, so related that their sines will be equal; for if they are not, ρ will have two different values, numerically considered, and therefore s, the projection of the helix, will be equal in length to arcs of two different circles subtended by a common chord; which is impossible. (See Davies' Legendre, Bk. v., P. 17.)

Again, since the relation expressed by (11) must always hold, that expressed by (10) must also, in order for ϕ to be real. The assumed condition which determines (10) is, that the helix shall not pierce the vertical plane passing through A and B.

If $\phi < 45°$, the helix will be projected into an arc less than a semicircle; if $\phi = 45°$ the projection of the helix will be a semicircle; and if $\phi > 45°$, the arc of projection will be greater than a semicircle. Having found ρ and ϕ, the arcs can be traced and the difficulties to be encountered, in constructing the road along either of them, ascertained. Several other routes may also be obtained. A B' may be divided into 2, 3, 4, or more parts, equal or unequal, and the helix located on as many tangent cylinders. The projection of the helix in all such cases will be a curve of contrary flexure. (See fig. 2.)

It is seen that ϕ and ρ can only be approximately determined, the nearness of the approximation depending upon the number of terms of the development of sin ϕ that is taken. If 4, 5, 6, &c., be employed, equations of the 6th, 8th, 10th, &c. degrees, will be obtained; but as they contain only even powers of ϕ, they may be reduced to equations of the 3d, 4th, 5th, &c. degrees, by introducing an auxiliary unknown

quantity. Instead, however, of attempting to solve those equations, it will be better perhaps, to proceed thus:—Having found an approximate value of ϕ from (7), (8) will give an approximate value of ρ—$\rho = r'$—. Substituting in (3) there will result

$$\phi = 2^{-1}\, r^{-1}\, h \cot a = \phi' \quad . \quad . \quad (12)$$

This in (4) gives

$$\rho = c \operatorname{cosec} \phi' = r'' \quad . \quad . \quad (13)$$

This in (3) gives

$$\phi = 2^{-1}\, r''^{-1}\, h \cot a = \phi'' \quad . \quad . \quad (14)$$

This in (4) gives

$$\rho = c \operatorname{cosec} \phi'' = r''' \quad . \quad . \quad (15)$$

&c. &c. &c.

The approximation should be continued in this manner, until ρ is correctly obtained to four decimal places. If, in any case, tan $a < 6^{-1}$ tan a', the helix cannot be located on a right cylinder with circular base, and must then be traced on some other surface or surfaces. (See article "Helices," &c., already referred to.) Since (7) gives only an approximate value for ϕ, the two values of ϕ will not be exact supplements of each, but will only approximate towards that relation, and will approach nearer and nearer to the state of having their sines equal to each other the farther the approximation is carried. The same remark holds, when, instead of employing (7) to find φ, 4, 5, 6, &c. terms of the development of sin ϕ are used.

When equations of higher degrees than these are employed to determine ϕ, the real and positive values obtained must either be supplements of each other, or so related that their sines are equal.

$$\text{Sin } \phi = \sin (\pi - \phi) = \sin (\pi + \phi) = \sin (2\pi - \phi) = \sin (2\pi + \phi) = \sin (m\pi \mp \phi) \quad . \quad . \quad (16)$$

m must be a positive even number. The values equated are the numerical ones, no attention being paid to the algebraic signs.

If four (4) terms of the development of sin ϕ be employed the resulting equation in ϕ will be

$$\phi^6 - 42\,\phi^4 + 840\,\phi^2 = 5040 - 10080\, c\, h^{-1} \tan a \quad . \quad (17)$$

Putting $x = \phi^2$, (14) becomes

$$x^3 - 42x^2 + 84x = 5040 - 10080\, c\, h^{-1} \tan a \quad . \quad (18)$$

If five (5) terms be employed the resulting equation will be

$$\phi^8 - 72\phi^6 + 3024\,\phi^4 - 60480\,\phi^2 = 725760\, c\, h^{-1} \tan a - 362880 \quad (19)$$

(19) may be put under the form

$$x^4 - 72x^3 + 3024x^2 - 60480x = 725760\, c\, h^{-1} \tan a - 362880 \quad (20)$$

Having found an approximate value for x from (19) or (20), there will result $\phi = \mp\sqrt{x}$. This in (4) will give an approximate value for ρ. Then apply the method of approximation already described.*

The helix may be located on several tangent cylinders, so that its

* See note 4, page 168.

projection may be a curve of contra-flexure, lying entirely on one side of A B′. Several examples are given. (See figs. 3, 4, 5.)

Fig. 3.

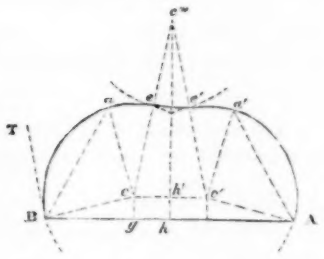


Fig. 4.

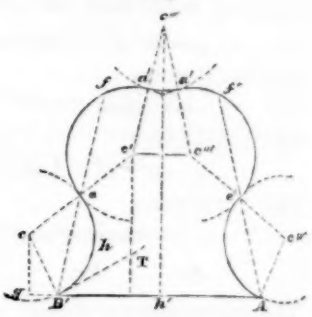
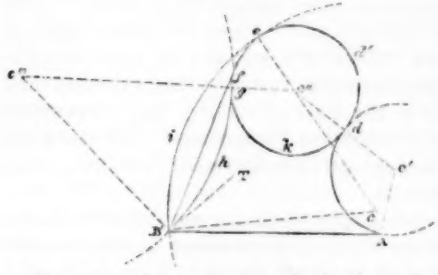


Figure 5 exhibits six routes for passing from A to B—they are not all of the same length in the diagram—A $d\,d'\,e\,i$ B′; A $d\,d'\,e\,f$ B′; A $d\,d'\,e\,f\,g\,h$ B′; A $d\,k\,g\,h$ B′; A $d\,k\,g\,f$ B′; A $d\,k\,g\,f\,e\,i$ B′. Now although, in practice, none of these may ever arise, especially none of the last three, yet it is easy to conceive of the circumstances under which it may be necessary to adopt any one of them.

Fig. 5.



Figs. 3 and 4 represent the helix as located on three (3) tangent cylinders. In fig. 4 it is located on four.

In fig. 3 $ed = ee' = e'\,d' = 3^{-1}\,dn'. = 3^{-1}Ad'$ = one-ninth of the entire horizontal development $c\,d = c'\,d' = c''\,e$. B′ d is an assumed chord taken sufficiently long to prevent too great curvature in the arc B′ d. Having determined $\rho = c\,d = r$, and $\phi =$ B′ $c\,d =$ B, the horizontal development can be traced. In order to trace it, the angle which the curve at its initial point makes with A B′, must be found. Drawing B′ T tangent to the curve at B′, it makes with A B′ an angle.

$$\text{A B}'\,\text{T} = \text{A B}'\,c + c\,\text{B}'\,\text{T} = \text{A B}'\,c + 90°, \qquad (21)$$

Draw $e\,g$ perpendicular to A B′ and $c\,h'$ parallel to the same; thence $c\,h' = h\,g = 2\,c\,e \sin(6^{-1}\,\phi) = 2\,r \sin(6^{-1}\,\phi)$;

B′ $g = 2^{-1}\,c - 2\,r \sin(6^{-1}\,\phi)$; and $\cos$ A B′ $c = 2^{-1}\,c\,r^{-1} - 2 \sin(6^{-1}, \phi)$ or,

$$\text{A B}'\,c = \cos^{-1}\left[2^{-1}\,c\,r^{-1} - 2 \sin(6^{-1}\,\phi)\right] \qquad (22)$$

In fig. 4, $d\,f = d\,d' = d\,f' = 3^{-1}\,e\,h$ B′, and since,

B′ $e = e\,f = f'\,e' = e'$ A there results

$$\text{A B}'\,\text{T} = \text{B}\,c\,g = f\,c'\,d = 3^{-1}\,\text{B}'\,c\,e = 3^{-1}\,\phi \qquad (23)$$

If in fig. 5, the development A $d\,d'\,e\,f\,g\,h$ B′ be taken, the angle A B′T can be determined thus: In the plane figure A B′ $c'''\,c''\,c'$ all of the sides

are known together with the angles B′ c‴ c″, c‴ c″ c′ and c″ c′ A. Hence, A B′ c‴ can be found, and subtracting 90° from it, the remainder will be equal to A B′ T. That is,

$$A\,B'\,T = A\,B'\,c''' - 90°, \quad . \quad . \quad (24)$$

The angle made by the tangent to *e i* B′ at B′, is also readily found—likewise the angle made by *f* B′ with A B′. In all cases except the first ρ may be assumed so as to regulate the curvature of the arcs. ϕ and the chord will then be known.

Figs. 3, 4, and 5, have been introduced merely to show into what a variety of forms the helix may be projected.

The practical conclusion drawn from this investigation is as follows: when it is required to connect two points whose horizontal distance apart and difference of level are given, by a line making a constant angle with the horizon, the straight line connecting the points being too steep, the shortest line fulfilling the condition, may assume many different positions, several of which should be examined in detail, and that one selected which presents the fewest, or least formidable obstacles to the construction of the road. Much might be added here with regard to the importance of running numerous "trial lines," when the nature of the surface is such as present any difficulty in the practical solution of the problem. I forbear, however, to say more than I have already said on this subject. Any additional remarks may seem to be rather out of place in this paper, which is devoted to the solution of a special problem in practical engineering.

NOTES.

[1.] For an excellent *resumé* of the principles which should determine the construction of a road, see chapters i and v of Prof. Gillespie's work, "A Manual of Road-making." This work cannot be too highly commended. It is admirably suited for an introductory text book to the professional student, and although it does not go so fully into the matter as such a reader may desire, it is the better calculated to answer the purpose intended by the author, whose aim was to diffuse practical information in a popular form adapted to the capacity of the general class of readers and students.

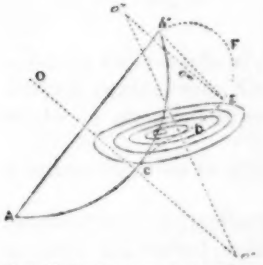
[2.] See Prof. Gillespie's work already referred to, page 233. It seems to be hardly necessary to add any thing to the preceding remarks, but lest any one should experience the least difficulty in comprehending how it is that a descent below, or an ascent above, the grade line can add, practically, to the difference of level between the two points, a height equal to twice the ascent or descent, an example will be given.

Referring to the example already suggested in the body of this paper, if in passing from A to B, three hundred (300) feet of their difference of level being overcome by a line rising uniformly from A to B, accordingly to the required grade, it being found necessary owing to the great irregularity of the surface, a valley intervening for instance, to descend one hundred (100) feet, a corresponding ascent will have to be made before the original difference of level, (360) feet, between B, and that point of the road where the descent began, can be restored. And this descent and ascent of an extra one hundred (100) feet will require a length of road equal to an ascent or descent of two hundred (200) feet; and the total length of road will be the same as if two hundred feet had been added to the difference of level of A and B, and the road had risen continuously according to the assumed grade from A to B.

Again, if after having overcome three hundred (300) feet of the difference of level between A and B, it be found necessary—a mountain intervening which it is judged best not to pierce by a tunnel—to ascend above the regular grade line to a height equal to one hundred (100) feet, the difference of level between B and the point where this ascent terminates, will be less by one hundred feet than the difference of level between B and the point where the ascent above the grade line began. Hence, only two hundred and

sixty (260) feet remain to be overcome, and if no corresponding descent be necessary, and if the horizontal distance from B to the point where the ascent began, be not increased, the total length of road from A to B may not be increased at all. But if, as will generally be the case under such circumstances, a corresponding descent of one hundred (100) feet be necessary before the surface of the ground is such that the road can ascend continuously from A to B, the total increase in length of road connecting A and B will be equal to that necessary to overcome a height of two hundred (200) feet, as already determined. It will be well to illustrate this last position by fig. 6.

Fig. 6.



Let A C B′ be the projection of the regular grade line as located on the surface of a right cylinder with circular base, and whose base passes through A and B′, C is three hundred (300) feet above A, and suppose that after having arrived at C, the superintending engineer concludes that it is best not to pierce the mountain intervening between C and B by a tunnel, but to deflect the road to the right rising above C one hundred feet to D. It will generally be necessary to descend at least one hundred (100) feet to some point as E, before the surface of the ground is such that the road can ascend continuously to B. This ascent and descent of one hundred (100) feet, will add five miles to the length of road connecting A and B, and it will, in general, be preferable to pierce the mountain and build the road along the line A C B′, rather than along the line A C D E F B′; but if the initial expense of constructing the road along the route C D E F B′, the yearly expense of keeping it in repair, and the wear and tear of the engines and cars over the same, be less than the aggregate of the corresponding items of expense along the line C B′, the engineer will be justifiable in making the deflection; otherwise he will not.

Further, if the difference of level between the highest point of road and A be greater than the difference of level between A and B, then the length of road connecting A and B, will be increased by an amount equal to at least that much necessary to overcome a height twice as great as difference of level between B and the highest point of road.

—

[3.] The line is evidently a helix, and it may be located upon a cylinder, a cone, a sphere, an ellipsoid, a paraboloid and a hyperboloid—or it may be traced upon several tangent surfaces—and in no two cases will the projections be the same, although they will all be of the same length.

—

[4.] Let $h = 660$ feet; $2c = 52{,}800$ feet; $\tan a = 1 \div 132$, which corresponds to a grade of forty (40) feet per mile.

$$\tan a' = 660 \div 52{,}800 = 1 \div 80 = \cdot 0125.$$

Hence $\tan a > 6^{-1} \tan a$.

Substituting in (7),

$$\phi = 1 \cdot 654, \text{ or } 4 \cdot 164.$$

To express ϕ in seconds.

$$\phi = 648{,}000 \times 1 \cdot 654 \div 3 \cdot 14159 = 341130 \cdot 4',$$

and reducing to degrees, minutes, and seconds,

$$\phi = 94°, 45', 30 \cdot 4''.$$

This value in (4) will give the first approximate valve of ρ. Substituting it in (3), the second approximate value of ϕ will be obtained. And so on, placing in (15), for c, h, and $\tan a$, their values then results,

$$x^3 - 42x + 840 = 21{,}840 \div 11.$$

By inspection $x > 2$ and < 3.

Assume $x = 2 \cdot 6$, there results,

$$x = 2 \cdot 4944 : \text{ and } \phi = \sqrt{x} = 1 \cdot 57,$$

for the first approximate value of ϕ, which can be employed as before.

The higher the degree of the equation employed, the more nearly correct is the value obtained for ϕ.

It is evident, that ρ is always greater than c.

Hence, instead of solving 7, 15, or 18, an approximate value for ρ greater than c may be assumed, and the method of approximation then applied to find ϕ and ρ correctly to four or five decimal places. It will be best, however, to solve one of the highest equations involving ϕ.

A word of explanation here, with regard to fractional and negative exponents. It is possible that this paper may fall into the hands of some whose limited mathematical knowledge will not enable them to comprehend the analytical solution of the problem, but who may be desirous to apply the results of the investigation. For the benefit of such, the following equivalent expressions are given:

$$a^{\frac{2}{3}} = \sqrt[3]{a^2} : (a^2-b^2)^{\frac{1}{2}} = \sqrt{a^2-b^2} : 6^{\frac{1}{2}} = \sqrt{6} : (63-48)^{\frac{2}{5}} = \sqrt[5]{(63-48)^2}$$

And generally,

$$a^{\frac{m}{n}} (r^2-s^3)^{\frac{p}{q}} = \sqrt[n]{a^m} \times \sqrt[q]{(r^2-s^3)^p}.$$

That is, any quantity raised to a power denoted by a fractional exponent, is equal to that root of the quantity whose index is the denominator raised to a power, the exponent of which is the numerator.

$$2 \cdot 7^{-1} = 2 \div 7 : 3 \cdot 4^{-3} = 3 \div 4^3 : 7 \cdot 9^{-\frac{1}{2}} = 7 \div 9^{\frac{1}{2}} = 7 \div \sqrt{9} :$$

$$(6a+7^{-1}b)^{-\frac{2}{3}} = 1 \div (6a+b \div 7)^{\frac{2}{3}} = 1 \div \sqrt[3]{(6a+b \div 7)^2}.$$

And generally,

$$a^{-m} b^{-n} c^{-s} d e = d e \div a^m b^n c^s.$$

That is, if there be several factors, some of which have negative exponents, the expression is equivalent to a fraction whose numeration is the continued product of the factors having positive exponents, and denominator the continued product of the factors having negative exponents, the signs of the negative exponents being changed.

AMERICAN PATENTS.

List of American Patents which issued from June 2d, to June 23d, 1857, *(inclusive.) with Exemplifications.*

JUNE 2.

1. For an *Improved Door Lock;* Thomas B. Atterbury, Pittsburgh, Penna.

Claim.—"1st, The use of the vibrating arm, which, whilst it acts as a tumbler to the bolt, serves, in combination with the follower, as a means of disconnecting the spindle from the bolt when the door is locked, and connecting them when unlocked. 2d, The use of an arm or lever, which, when pressing upon the tumbler of the lock, prevents its being raised, thus forming a guard which protects the locking bolt from any action of the key, and prevents the locking or unlocking of the bolt."

2. For an *Improvement in Sleeve Fasteners;* William A. Bates, Boston, Mass.

Claim.—"My improved bracelet clasp made with a slotted tongue and catch-hook, and with its body to spring lengthwise."

3. For an *Improvement in Skates;* R. W. Belson, Philadelphia, Pennsylvania.

Claim.—"Constructing the skate entirely of cast metal, and of two parts connected together."

4. For an *Improved Hydrant;* Wm. W. Binny, Seneca Falls, New York.

Claim.—"The pipe, fitted within the case and within the tube or neck; the pipe having a flanch or collar upon it above the neck, and provided with a valve at its perforated lower end, said pipe being fitted within the neck or tube, and used in connexion with the box or chest, and spring."

5. For an *Improvement in Fastenings for Garments;* Jeremy W. Bliss, Hartford, Connecticut.

Claim.—"The new manufacture of fastening for garments, to wit: a plain or ornamental plate or bar, having sharp hooks permanently fastened to it, pointing towards each other or towards the centre, so arranged as to be conveniently hooked into the garments to be fastened or unhooked therefrom."

6. For an *Improvement in Mowing Machines;* Silas P. Briggs, Saratoga Springs, New York.

Claim.—"The peculiarly constructed attachment, when connected to, and used in, combination with the Ketchum mowing machine."

7. For an *Improvement in Printing Presses;* Jason L. Burdick, City of N. York.

Claim.—"1st, The arrangement of working the roller upon which the type is attached, in such a manner as to communicate to the same a forward and backward motion in connexion with a rotating motion. 2d, The arrangement of a guide piece for the purpose of guiding the type roller in the latter part of its forward motion, so as to bring the types always square against the platen containing the paper or card to be printed."

8. For an *Improved Door Hinge;* S. M. Bullard, Holliston, Massachusetts.

Claim.—"The detached anti-friction roller, inserted between two inclined planes."

9. For an *Improvement in Machines for Preparing the Fibre of Banana, Plantain, Aloe, &c.;* Francis Burke, British West Indies; patented in England July 14, 1855.

Claim.—"The combination of the beating cylinder with the endless apron and yielding table or surface under the apron."

10. For an *Improvement in Method of Hanging Mill Stones;* Wm. A. Clark, Samuel D. Porter, and Wm. D. Simpson, St. Louis, Missouri.

Claim.—"Suspending the upper stone from above by means of a ball and socket-joint (or its equivalent), when the eye of the said stone is made to embrace the upper portion of the spindle of the running stone, and is secured thereto with a sufficient degree of rigidity by means of an elastic packing."

11. For an *Improvement in Packing Pistons and Stuffing Boxes of Steam Engines;* Patrick Clark, Rahway, New Jersey.

Claim.—"The foil or plastic sheet metal packing."

12. For an *Improvement in Steam Pumping Apparatus;* George H. Corliss, Providence, Rhode Island.

Claim.—"The arrangement of a series of steam cylinders and pumps, combined radially around a central crank shaft with a central crank and crank shaft, with which the whole series of pumps and steam cylinders are connected. 2d, The method of forming the connexion between the pistons of a series of cylinders, and a single crank pin, by means of a disk ended connecting rod, and which is appropriated to one piston in the series, and which is fitted with a series of pins to which the remaining connecting rods of the series of cylinders are applied, thus obviating the direct application of all the connecting rods in the series to the same crank pin."

13. For an *Improved Lock;* Julius M. Cook, Hinsdale, Pennsylvania.

Claim.—"The set, arranged and operating in connexion with the wheels, fly, and shaft."

14. For an *Improved Water-Wheel;* Reuben Daniels, Woodstock, Vermont.

Claim.—"The use of the flanch, or its equivalent."

15. For an *Improvement in Sewing Machines;* James E. A. Gibbs, Millpoint, Va.

Claim.—"The revolving hook constructed and arranged in relation to, and operating in connexion with, the needle. Also, when sewing with a single thread, interlacing or twisting the threads of the loop after passing the cloth to be sewed, and before taking a fresh loop."

16. For an *Improvement in Potato Diggers;* Isaac Griffen, Quaker Springs, N. Y.

Claim.—"The arrangement of the drag, axle, and swinging fork."

17. For an *Improvement in Ploughs;* John S. Hall, West Manchester, Pennsylvania.

Claim.—"Vibrating the beam in a circular bearing in the land side, together with the oblique adjusting and securing slots, whereby the draft end of the beam may be vertically adjusted, and the beam so secured to the land side as that it is impossible for the former to slip."

18. For an *Improved Block for Blacking Boots and Shoes;* Francis G. Harding, Boston, Massachusetts.

Claim.—"The new article of manufacture consisting of the thin metallic shells, hinged at the former, having an extension to serve as a handle to the implement, and fitting the front inside of the shoe, and the latter fitting the inside of the heel, the said shells being distended, and the shoe thereby firmly held by means of the screw passing through the shell, and abutting against the projection of the shell."

19. For *Improved Gauge Attachments for Hand Saws;* Michael Kennedy, Troy, New York.

Claim.—"Making the gauge for regulating the depth of the saw-cut with adjustable clamps which are formed to fit and gripe the saw-back, and are attached to the arms of the gauge independently of the set-screws by which the clamps are fastened to the saw-back, so that the gauge cannot only be fastened at any desired place upon the blade, without requiring the blade or the saw-back to be perforated, but so that the gauge can also be removed from and replaced upon the saw, without altering the set of the gauge, and so that the gauge can be adjusted upon the blade without loosening the clamps which hold the gauge to the saw."

20. For an *Improved Faucet;* Lucius J. Knowles, Warren, Massachusetts.

Claim.—"Combining with or arranging with respect to the valve stem and eduction passage of the body of the faucet, the secondary chamber or drip passage. Also, arranging an annular groove in that part of the valve stem which slides in and out of the recess of the body of the faucet."

21. For an *Improvement in Life Preservers;* James Knight, City of New York.

Claim.—"The construction of the supporter to sustain the head in the position assumed by persons when swimming, thus releasing the wearer from muscular effort, and attached to this supporter a shield to protect the mouth and nostrils from the violence of the waves, and this supporter and shield fitted to the ordinary life preservers as worn round the body, by having attached to them sheaths, one of them fitted with a sheath to admit the stem of the supporter for adjustment to the wearer; the whole when combined constitutes my improvement."

22. For an *Improvement in Feeding Gas Generators;* C. B. Loveless, Syracuse, New York.

Claim.—"The connexion of the feeder with the retort by the arrangement of pipes, when combined with a cut-off valve."

23. For an *Improvement in Locomotive Boilers;* J. E. McConnell, Wolverton, England; ante-dated December 2, 1856.

Claim.—"The fire-box increased in size so as to extend into the barrel of the boiler, and in connexion therewith the tubular stays conveying a supply of fresh air into the extension, whereby the products of combustion are consumed in a more perfect manner. Also, the water tubes, arranged in relation to the fire-box, and the surrounding boiler."

24. For an *Improved Scroll Sawing Machine;* John J. Curtis, East Boston, Mass.

Claim.—"1st, The rotating bed or table, and in such a relation to the saw, that the bed or table may rotate around the cutting edge of the saw as a centre. 2d, The feeding wheel, when used in connexion with a rotating bed or table."

25. For an *Improvement in Machines for Sowing Seed Broad-cast;* Daniel Haldeman, Morgantown, Virginia.

Claim.—"The vertically adjustable graduating bar with recesses, in combination with the vibrating scatterer and agitator connected therewith."

26. For an *Improvement in Manufacturing Screws of Thin Metal;* John L. Mason, City of New York.

Claim.—"The mode of forming screw threads on cups, hollow cylinders or hollow cones, of thin soft metal."

27. For an *Improvement in Machines for Harvesting Hemp;* John B. McCormick, Versailles, Kentucky.

Claim.—"The combination of the adjustable bar and seat, with the bars, rods, movable bar, and narrow platform, when said parts are arranged in relation to each other, to facilitate the harvesting of hemp."

28. For an *Improvement in Atmospheric Churns;* Robert McCutcheon, Towanda, Pennsylvania.

Claim.—"The bellows, the chambers, and the air pipe, when arranged in relation to each other and to the body of the churn."

29. For an *Improvement in Machines for Sowing Seed Broad-cast;* A. C. Miller, Morgantown, Virginia.

"The invention consists in providing the seed box of a sowing machine with a peculiar kind of false bottom for the seed to rest upon, thus preventing the seed from bearing with its full weight on the seed bar, while the seed drops through notches in said false bottom into the seed box, and thence to the ground."

Claim.—"In combination with the adjustable bottom and its openings, and the stirrers, the secondary hinged bottom, composed of the two pieces with their openings, the whole being combined."

30. For an *Improved Implement for Paring Horses Hoofs;* V. N. Mitchell, Concord, North Carolina.

"This improvement consists in dressing or paring the hoofs of horses, and other animals, by placing the bottoms of the hoofs in contact with a knife or cutter, which has an exact movement, and is operated by mechanism."

Claim.—"The reciprocating frame provided with the knife and plate, the frame being attached to the upright, having a recess in its upper end."

31. For an *Improvement in Cast Iron Car Wheels;* Albert L. Mowry, Cincinnati, Ohio.

"The object of my improvement consists in making a wheel free from strain, that strain which is more or less produced by the unequal cooling of the parts of the wheel."

Claim.—"Providing the hub with a concave or other formed channel around the centre of the circumference, and arranging in the said channel the lead and ribs, and then with the hub thus constructed, uniting it with the wheel when the parts of the wheel are made and proportioned."

32. For an *Improved Fluid Metre;* James R. Maxwell, Cincinnati, Ohio.

"The improvement consists in the manner of combining and arranging the parts of the metre together, which prevents the settling of dirt in the apparatus often contained in the water, and causes the metre to work with ease and certainty."

Claim.—"The arrangement of the piston with the parts employed for moving the valve."

33. For an *Improvement in Churns;* Henry C. Nicholson, Mt. Washington, Ohio.

Claim.—"So arranging of the flutter wheels upon bent arms, as that the cream agitated by them shall not re-act against any dividing surface, or be impeded by any surrounding piece, and thus I allow the agitation to be more direct in a vertical line, and not follow the rotation of the shaft on which they are placed."

34. For an *Improved Process of Manufacturing Leather Shoe Binding;* Eugene L. Norton, Charlestown, Massachusetts.

Claim.—"The improved process of manufacturing shoe binding, by dividing the skin or sheet of leather into strips of equal width, joining them at their ends so as to connect them into one long strip, and coloring the same when so formed, the whole being formed of, or reduced to, an uniform thickness, and the fleshy or surplus portions of the leather removed by splitting or otherwise."

35. For an *Improvement in Feeding Grain to Mill Stones;* Milton and Charles Painter, Owing's Mills, Maryland.

Claim.—"Regulating the feed of the grain by the swaging of the cup."

36. For an *Improved Hydraulic Gas Generator;* August F. W. Partz, City of N. Y.

Claim.—"1st, The arrangement of the several parts of my machine. 2d, A cham-

ber attached to, and communicating near, its bottom, with the vessel enclosing the wheel, into which chamber the hollow shaft of said wheel opens and discharges, and which contains an outlet for the air accumulating in its upper part"

37. For an *Improved Apparatus for Condensing Vapors and Gases, and for Evaporating Liquids;* August F. W. Partz, City of New York.

Claim.—"The combination of the revolving perforated disks or sheets, with the vessel containing the liquid of absorption or evaporation into which they dip, and the hood or cover which guides the vapors and gases that are introduced through the unimmersed portions of said disks"

38. For an *Improvement in Oscillating Printing Presses;* Charles Potter, Jr., Westerly, Rhode Island.

"The invention consists in an improved method of regulating the impression, and also of feeding in, and throwing out, the sheets, and is applicable particularly to the press patented by Merwin Davis, July 24, 1855."

Claim.—"1st, The manner of adjusting the impression by means of the levers and screws. 2d, The use and adaptation of the lifting feed board, for carrying the sheet to the grippers, when combined with the oscillating eccentric segment. 3d, Operating the 'fly' by the cam, when so constructed as to cause said 'fly' to conform to the motions of the bed, and oscillating eccentric segment."

39. For an *Improvement in Seed Planters;* Silas G. Randall, Dixon, Illinois.

Claim.—"Hinging the seed hopper with its drive-wheel and other appliances connected with it, to the side pieces of the harrow by the pivoted arms, so that when said hopper is thrown forward, it shall rest on, and be operated by, said drive-wheel, which runs on the ground for that purpose, and when thrown back, rests on said side pieces, and be out of action."

40. For an *Improvement in Harvesters;* Wm. T. B. Read, Alton, Illinois.

Claim.—"Making the shoe in one piece, so that by its peculiar formation, it shall serve not only as a support for the finger bar, and as a support and guide for the inner end both of the sickle bar and connecting rod, but also as a means of preserving the connexion between the connecting rod and the sickle bar."

41. For an *Improved Machine for Making Shovels;* David B. Rogers, Pittsburgh, Pennsylvania.

Claim.—"The use of the rollers, in connexion with the dies and the pitman."

42. For an *Improvement in Die Stock;* John F. Scharer, City of New York.

Claim.—"The arrangement of the die plate when held steadfast, in connexion with the die plate, having a slight adjusting motion."

43. For an *Improved Portable Cross-cut Sawing Machine;* Stephen Scotton, Wayne Co., Indiana.

Claim.—"1st, The peculiar arrangement for feeding the saw to its work, and for changing the saw from a perpendicular to a horizontal position. 2d, A slotted saw and screw bolt. 3d, A block, in combination with the dog."

44. For an *Improved Heel Cutter for Cutting Out Heels of Boots and Shoes;* John Shaw, Natick, Massachusetts.

"The object of my invention is to separate each waste portion entirely from the strip during the foundation of each heel portion."

Claim.—"The cutting wings extended from it, and so as to remove the waste portion from the strip of leather, while the heel-piece is being formed therefrom."

45. For an *Improvement in Cooking Ranges;* Charles J. Shephard, Brooklyn, N. Y.

"The invention relates to the construction of the oven plate next the fire, which is so formed as to produce an enlargement of the oven, and also act as a burning and conducting plate and radiator, to heat the oven at that part which is now generally deficient in operation, thereby heating the ovens more uniformly and with less fuel."

Claim.—"Forming the plate that encloses the whole side of the oven next the fire, with the conductor and radiator, whereby the said radiator, in contact with the fire, conducts the heat to, and disperses the same throughout, the side oven plate, heating the

oven more uniformly, and preventing burning, at the same time that the oven is enlarged."

46. For an *Improvement in Printers' Composing Sticks;* James and Wm. Tidgewell, Middletown, Connecticut.

Claim.—"The application to the slide of a composing stick of the flanch and the screw, in combination with the washer interposed between the point of the screw, and the exterior surface of the foot or bottom stile of the stick."

47. For an *Improved Machine for Filing Saws for Cotton Gins;* Jonathan T. Turner, Bridgewater, Massachusetts.

Claim.—"Giving the files a reciprocating rotary or rolling motion. Also, the adjustable vibrating frame, carrying the traverse rods which operate the files when arranged to vibrate parallel with the plane of the saws, so as to adjust and adapt the files to the saws. Also, giving the saws a continuous rotary motion while they are operated upon by the files, by means of a belt applied directly upon the saw cylinder. Also, a yielding or spring fire holder, in combination with a traversing rod having a reciprocating rolling motion."

48. For an *Improved Method of Uniting the Panels of Portable Fences;* Charles Van De Mark, Oaks Corners, New York.

Claim.—"The end locking piece or board, combined with the locking board and rails."

49. For an *Improvement in Folding Bedsteads;* John B. Wickersham, City of New York.

Claim.—"Securing the side rails in place when the bedstead is in an unfolded position, by the combined operation of the shoulder and pin, inserted above the rail."

50. For an *Improvement in Hat Stands;* John B. Wickersham, City of New York.

Claim.—"The manner of attaching the hooks of hat stands on vertical studs or rods, so that said hooks can be turned around horizontally."

51. For an *Improved Plough Clevis;* J. D. Willoughby, Pleasant Hall, Penna.

Claim.—"The stem and button with its grooves, in combination with the cylinder and its elevation."

52. For an *Improvement in Printing Presses;* Daniel K. Winder, Cincinnati, Ohio.

Claim.—"The construction and arrangement of the roller bearing pivoted to the flattened branch or arm from the driving shaft, and provided with the sliding spring button, in combination with the hook, or equivalent device, for the tripping and inversion of the inking roller between the consecutive inkings."

53. For an *Improvement in Door Bolt;* Amos Westcott, Syracuse, New York.

Claim.—"The supporting and guiding of the rear or inner end of the bolt, by connecting it with the knob shaft."

54. For an *Improvement in Wood Gas Generators;* Charles F. Werner, City of New York.

Claim.—"The arrangement of a movable boiler or retort and cylinder."

55. For an *Improved Hand Implement for Severing the Butts, and Separating Husks from Ears of Corn;* Isaac N. Whitaker, Pecatonica, Illinois.

Claim.—"The cutters and flanches or lips attached to the levers."

56. For an *Improved Machine for Dressing Water Furrows in Land;* Jesse Whitehead, Manchester, Virginia.

Claim.—"In combination with the coulter and mould-boards, which scrape off and smooth the sides of the furrow, and serve to guide and direct the machine along said furrow, the horizontal plate which shaves off the top of the furrow, receives all the excess of earth, and the distributors for scattering the earth therefrom, so as not to leave it in ridges."

57. For an *Improvement in Pickers for Looms;* Thomas J. Mayall, Roxbury, Assignor to self and George N. Davis, Boston, Massachusetts.

Claim.—"A picker made of hard vulcanized rubber without seams."

58. For an *Improvement in Hominy Machines;* Oscar F. Mayhew, Assignor to self and W. H. Weeks, Indianapolis, Indiana.

Claim.—"The combination and arrangement of the concave rings or division, and the adjustable openings."

59. For an *Improvement in Holders for Sad Irons, &c.;* Leon Londinsky, Assignor to self and Adolphus E. Becker, City of New York.

Claim.—"A detachable handle or holder made in sections of wood, to be placed upon the handle of a smoothing iron for tailors and hatters, and laundry use."

60. For an *Improved Process of Splitting Leather and Hides;* Isaie Lippmann, Paris, France, Assignor to Michael J. A. Guiet, City of New York.

Claim.—"The method for splitting skins, and by first submitting them to a fulling or beating action, and then when so prepared, passing them through an apparatus or machine, the cutting apparatus of which has a rapid vibrating motion, against which the skin is projected slowly, by which method of fulling and cutting combined, I am enabled more perfectly to split skins than has heretofore been done."

61. For an *Improvement in Water Gauges for Steam Boilers;* Datus E. Rugg, Assignor to self and Dexter N. Force, City of New York.

Claim.—"The combination of the metallic pipe connected to the steam and water spaces with the surrounding transparent tube or cylinder, to indicate by the ebullition of the fluid in said cylinder the water level of the boiler."

62. For an *Improvement to Prevent Counterfeiting Bank Notes, &c.;* Christopher D. Seropyan, Assignor to Wm. Cousland, City of New York, and John D. Bald, Philadelphia, Pennsylvania.

Claim.—"The application of at least two colors to the manufacture of bank notes, drafts, and all other papers representing value, both of which will equally or nearly so absorb the chemical rays of light, or neither of which will transmit or reflect such rays and leave the colors or the tint of the paper less fugitive than the color of the other parts."

63. For an *Improvement in Door Bolts;* Samuel R. Wilmot, Assignor to Samuel B. Guernsey, Watertown, Connecticut.

Claim.—"The method of forming a raised bar from a flat plate without straining the material injuriously by corrugating the plate at the ends of the bar, and slitting the sides of the bar from the plate."

64. For an *Improvement in Dies for Punching Fork Tines;* Le Roy S. White, Assignor to S. S. Rogers, E. W. Sperry, James H. Ashmead, and Edmund Hurlburt, Hartford, Connecticut.

Claim.—"Supporting the small bars or slender parts of the tempered die by suitable supports or dies of metal."

65. For an *Improvement in Ploughs;* John Ormiston, Centre Township, Assignor to D. N. Allard, Rokeby, Ohio.

Claim.—"Uniting and adjusting the shank of the point to, and with, the shank of the coulter, by means of the head on said piece, the rack on the shank of said coulter, and the stirrup and set-screw."

JUNE 9.

66. For an *Improved Blotter;* R. G. Allerton, City of New York.

Claim.—"A blotter having a convex surface containing the blotting material with a handle in the opposite side, so as not to revolve, but to be used by a single rocking motion."

67. For an *Improved Machine for Repairing Railroad Bars;* Lyman Beebe and George F. Smith, Michigan City, Indiana.

Claim.—"The wedge shaped jaws fitted to the iron to be worked, in combination with the iron bed block fitted to receive them, into which they slide, and by which they are firmly held. Also, the two jaws, in combination with the double lever, in which

they rest, and by which they are readily opened by raising to receive and discharge the rails."

68. For *Improved Devices for Holding the Bit in the Brace;* George Benjamin, Avoca, New York.

"The invention consists in providing the brace or bit stock with a convenient and substantial fastening, to hold the bit firmly to the bit stock."

Claim.—"The invention of the hook and lever and standard, as applied to the brace socket, and the application of the spring No. 6, the burr No. 7, and the notch No. 8, on the outside of the brace socket."

69. For an *Improved Machine for Rounding and Backing Books;* Theodore Bergner, Philadelphia, Pennsylvania.

Claim.—"1st, Giving a sliding motion to the clamps by means of segments and pinions, or any equivalents to the same. 2d, The sliding table, plates, and clamps, in combination with the swing frame and rollers. 3d, The employment, in combination with the sliding clamps, of adjustable blocks."

70. For an *Improvement in Machines for Covering Insulated Wire with Lead or other ductile metal;* Samuel C. Bishop, City of New York.

"The improvement in the machine employed in the process to produce my said manufacture, consists of a combination of tubes, or other equivalent conductors, for a current of fluid with the die."

Claim.—"Causing the metal and insulated wire to move in separate channels toward a die, where they are to be united, and preventing the gum from being heated while it and the lead advance toward the die, by a current of fluid passing in a suitable vessel or vessels between the metal and gum, to receive and carry off the caloric."

71. For an *Improved Machine for Grooving Stove Pipe;* Charles Bigelow, Hastings, Minnesota.

Claim.—"The roller having its periphery or face formed of a grooved or concave surface and a flat surface, the roller being placed within a reciprocating bar, and within a yoke, arranged and actuated by the lever and ledges, whereby the roller is shifted or moved automatically at the ends of its strokes or movements, and made to groove and close the joints or seams of the pipes at one operation. Also, the bar, when jointed to the upright, and secured to the projection by the pin, as used in connexion with the lever and spring, so that said bar may be thrown out automatically from the projection, for the purpose of allowing the finished pipe to be removed readily therefrom, and another placed thereon."

72. For an *Improved Steam Heating Stove;* Asa Blood, Norfolk, Virginia.

"The invention consists in making a stove greatly improved, for the purpose of burning wood or coal, and heating by the aid of hot air and steam."

Claim.—"The arrangement of the water chamber, chambers, pillars, and hollow grates, and tubes."

73. For an *Improvement in Machines for Paring, Coring, and Quartering Apples;* Charles F. Bosworth, Petersham, Massachusetts.

"The invention consists in a cheap, simple, and effective method of taking the core from an apple, and cutting the same into cylinders after it has been pared."

Claim.—"In combination with stationary quartering and coring knives, the fork shaft, when so arranged in relation to each other, and to the mechanism operating the machine, that it shall steadily propel the apple in the direction of, and while revolving upon, the axis of the corer, whereby one or more apples may be quartered and cored, while another is pared."

74. For an *Improvement in Metallic Band Fastening for Bales, &c.;* Asa O. Broad, Louisville, Kentucky.

"The invention consists in the peculiar device for uniting the two ends of a metallic hoop for securing bales, packages, &c., and so that it may be readily disconnected, without cutting the hoop or band."

Claim.—"A metallic hoop or band, whose ends are united by the bows or curves, slide, and pin."

75. For an *Improved Self-Loading Cart;* J. S. Brown, Washington, D. C.

Claim.—"The combination of a revolving elevator and a scraper. Also, the employment of the cranks on the axle, for the purpose of raising and lowering the elevator and scraper by simply turning the axle half a revolution. Also, the use of the winch, attached to the projecting end of the axle, for the purpose of giving the proper movement to the said axle. Also, the arrangement of the lifting bars, cranks, hangers, and brace bars. Also, the stops on the frame, arranged in combination with the cranks."

76. For an *Improvement in Machinery for Manufacturing Felt Cloth;* Thomas B. Butler, Norwalk, Connecticut.

Claim.—"1st, The flanched track plates. 2d, The movable tripping plates. 3d, The rising frame and rolls."

77. For an *Improvement in Carpet Fastenings;* David N. B. Coffin, Jr., Newton, Massachusetts.

Claim.—"A screw having a head arranged at one side of its axis, that it may be so applied that the screws may require a turn of only a part of a revolution to secure or to release the carpet after being screwed into their places, and whereby it is made practicable to take up a carpet and replace it in a very short space of time, and with great ease; in other words, I claim the eccentric headed screws for securing carpets to floors, and for similar purposes."

78. For an *Improvement in Machines for Drying Paste-Board or Paper;* Patrick Clark, Rahway, New Jersey.

Claim.—"The arrangement of the series of hollow heating plates for drying purposes."

79. For an *Improved Catch for Doors;* Jeremiah M. Crosby, Norwalk, Ohio.

Claim.—"The employment of the additional soft spring and connecting slide, or its equivalent, between and in combination with the bolt and main spring."

80. For an *Improved Railroad Switch Lock;* Wm. L. Cawthron, Harper's Ferry, Virginia.

Claim.—"The arrangement upon the lock plate of the curved securing arm."

81. For an *Improvement in Bakers' Ovens;* John Chilcott, Brooklyn, New York.

Claim.—"Providing each car by which the bread is conveyed to and from the oven with a pan or tray that is hung upon journals, and is overturned at a suitable stage in the baking process by the automatic mechanical agency, for the purpose of inverting the position of the bread, and thus causing the bread to be baked more uniformly."

82. For an *Improvement in Rope Machines;* William R. Dutcher, Lansingburgh, New York.

Claim.—"The self-adjusting thimble combined with the cone, when kept towards the said cone by suitable yielding pressure, for the purpose of laying up either the strand or rope, and adjusting itself to any inequality without breaking either the yarns or strands."

83. For an *Improvement in Roofing Machines;* J. B. Driscole, Knoxville, Tenn.

Claim.—"The employment of a swinging bar, hinged or swung between the frame or side plates."

84. For an *Improvement in Grain Separators;* Elisha Dowd, Oshkosh, Wisconsin.

Claim.—"The vibrating shoe provided with the screens, and arranged relatively with the box or chest and deflecting board, in combination with the trunk and fan."

85. For an *Improved Card Printing Press;* Charles E. Emery, Canandaigua, New York.

Claim.—"1st, The general construction of the machine, and the arrangement and combination of its parts, said parts being arranged, combined, and operated in a manner so as to accomplish the object of the invention, the operation of each part being adapted to the vibratory movement by which the machine is operated, and the pressure feeding and discharging contrivances of the machine being combined with the inking arrangement, or with one equivalent to it. 2d, The manner of adjusting and operating the grippers which hold the card, in combination with the manner of operating and

stopping the operation of the plate upon which the card is laid, both being operated by the simple vibratory movement of the moving surface which gives the impression."

86. For an *Improved Machine for Making Horse-Shoe Nails;* Calvin Carpenter, Jr., Providence, Rhode Island.

Claim.—"1st, The attachment of the lower dies to, or the construction thereof, as a part of a plate, which has such a sliding movement, horizontally or otherwise, below the cutter, at right angles to the movements of the cutters, and closing movement of the dies, that the die receives the blank from the cutters while it is in a stationary condition, and then conveys it under the top die, and in returning has the finished nail pushed off it by the lower cutter. 2d, The gauge applied to the lever, or its equivalent, which carries the upper die, in combination with a stationary slotted standard, by which it is moved out of the way as the dies close, and which also serves to adjust it to give a greater or less width to nail blanks."

87. For an *Improved Self-acting Wagon Brake;* M. C. Chamberlain, Johnsonsburgh, New York.

Claim.—"The arrangement of brake bars, slotted arms, and levers, when used for self-acting brakes for vehicles."

88. For an *Improved Mitre Box;* George L. Chapin, Perrysburgh, New York.

Claim.—"The arrangement and combination of the obtuse angled part with the tilting box, both parts being adjustable relatively to each other and to the fixed supporting frame."

89. For an *Improved Machine for Preparing Hub Blocks for the Lathe;* Lovett Eames, Kalamazoo, Michigan.

Claim.—"The vertical and stationary hollow auger guide and rest plate, with cutters attached, in combination with the rotating arbor and screw clamp, attached to the sliding frame."

90. For an *Improvement in Melodeons;* William Evans, Lockport, Illinois.

Claim.—"The arrangement of the swell to close by a movement upwards or away from the reed tubes, instead of downwards or towards the reed tubes in the heretofore usual manner. Also, the stop against which the swell closes attached to the reflecting board, so as to be removed therewith to leave the reeds exposed."

91. For an *Improved Machine for Making Wrought Nails;* Smith Gardiner, City of New York.

Claim.—"1st, The feeding apparatus. 2d, Projecting the finished nail to the rear of the anvil to be cut off. 3d, The eccentric and spring to hold the nail rod when rapidly brought back to its place. 4th, Vibrating the rod under the two hammers, so as to alternately receive a blow on its different sides. 5th, The general combination and arrangement of the several parts of the machine for feeding, presenting, swaging, and cutting off the finished nail, by which I make a wrought iron nail of any specified pattern."

92. For an *Improved Method of Guiding and Cushioning Puppet Valves;* Joseph Hyde and Wm. Stearns, Wilmington, Delaware.

Claim.—"The application to steam engine pump valves, the brace with the piston working into the chamber or cushion to prevent mashing or bruising of the valves."

93. For an *Improved Frame for Camp Tents;* Benjamin Hinckley, Troy, New York.

Claim.—"Making the raftered frame of the tent in sections, hinged together so that the frame can be folded for convenient carrying, the folding frame being provided with the jointed tie-braces, or equivalent devices, for keeping the sections in place when expanded."

94. For an *Improvement in Clay Pulverizers;* Ira Hersey and J. H. Van Riper, City of New York.

Claim.—"The combination of the grated cylinder or separator, open at its ends and supported on its outside by the driving wheels, with the movable and adjustable beaters on the shaft, when the same are constructed and arranged for joint operation."

95. For an *Improvement in Carriage Brakes;* George Hauck, Mechanicsburg, Pa.

Claim.—"Providing the semicircular locking block with an extension arm, and

pivoting it to a bracket of the axle some distance from the point of contact with the hub, and arranging it relatively to the lever and spring."

96. For an *Improvement in Solar Lamps;* Joseph Hassell, Brooklyn, New York.

Claim.—"Making the outer and turning wick tube which surrounds the wick holder, with a helix or helices, to act on a pin or stud projecting from the said wick holder, and preventing the said wick holder from turning by a feather or feathers, or equivalent therefor, on the outer surface of the inner wick tube, in combination with the making of the upper end of the inner and outer wick tubes cylindrical, and with unbroken surfaces in contact with the wick, the better to keep the upper end of the wick parallel with the upper end of the said wick tubes, and for the further purpose of having the surface of the said tubes, where they are in contact or close proximity with the wick, to present unbroken cylindrical surfaces. Also, in combination with the turning wick tube provided with a helix or helices, the employment of a movable nozzle."

97. For an *Improvement in Sewing Machines;* Daniel Harris, Boston, Mass.

"The improvement relates to the mechanism for producing in connexion with the needle, the chain or tambour stitch, and is for application to such machines only as are to sew with this stitch."

Claim.—"The mechanism for forming and interlooping the stitches, consisting of the leak, the catch, the plate, and its projection, the spring, and the needle, when constructed, arranged, and operated together."

98. For an *Improved Wheelwrights' Machine;* E. N. Kilpatrick, Byhalia, Miss.

"The invention is a machine intended for the use of wheelwrights to facilitate the various operations in constructing carriage wheels, and to insure greater accuracy in performing those manipulations."

Claim.—"The combined arrangement of the spoke marking apparatus, cutter frames, gauge rod, and hub holders, in such relation to each other as to enable the tenons of the spokes to be marked and formed with entire uniformity and unerring accuracy."

99. For an *Improvement in Coal Stoves;* John B. Kohler, Philadelphia, Penna.

Claim.—"The three cases, the fire chambers, and their respective openings, the air chambers, with their openings and the partitions."

100. For an *Improved Basin Faucet;* Wm. C. Marshall and Horace W. Smith, Hartford, Connecticut.

Claim.—"The arrangement, application, and combination for drawing hot or cold water through one nozzle."

101. For an *Improved Machine for Felling Trees by Hand;* Elliot T. Miller, Chelsea, Massachusetts.

Claim.—"The vibrating bar with cutter attached, the bar being pivoted in the sliding collar provided with the pawls, and fitted on the rack bar which is attached to the tree by means of the brace and clamp formed of the screw rods passing through the nuts attached to the segment bar, and retained in proper position by the bars."

102. For an *Improvement in the Mode of Hanging Doors;* Albert W. Morse, Eaton, New York.

Claim.—"Giving the roller an independent motion of the door, thereby allowing the roller to adjust itself to the rail, and revolve on it with its plain parallel with said rail."

103. For *Improved Portable Fence;* William Morrison, Carlisle, Penna.

Claim.—"Confining the panels together, and also to the braces and sill, by means of a single bolt."

104. For an *Improvement in Constructing Watch and Locket Rims;* Henry A. Phillips, Providence, Rhode Island.

Claim.—"The shaping burnisher, or its equivalent, for the purpose of producing a continuous rim from the same metal upon the halves of watch and locket cases."

105. For an *Improvement in Rotary Pumps;* Robert Ramsden, South Easton, Pa.

Claim.—"The combination of a revolving piston and taper shaped screw."

106 For an *Improvement in Automatic Fans;* Lawrence Rebstock and Nicholas Reimel, Philadelphia, Pennsylvania.

Claim.—"A new article of manufacture, a ventilating fan."

107. For an *Improved Shield and Guide for Circular Saws;* George W. Rodeboy, Milwaukie, Wisconsin.

Claim.—"1st, Suspending over the upper half of a saw which is arranged to hang over the log to be sawed, a stationary metallic shield, for the purpose of supporting the muley head, and serving as a guard to prevent injury to the operator. 2d, The peculiar manner of arranging the circular muley head on the stationary elevated shield, whereby the guides are capable of being adjusted to any position desired, without taking up any portion of the depth of the saw from the collar to the point of the teeth, and are always made to guide the saw just at and above the point of cutting. 3d, The spring, when arranged on the rising and falling muley head, and relatively to the saw."

108. For an *Improvement in Making Lamp Black;* Julius A. Roth, Philadelphia, Pennsylvania.

Claim.—"Supplying lamp black ovens or the flues connected therewith, with air pipes. Also, the combination of the discharging flue or pipes with a tank or reservoir filled with water."

109. For an *Improved Method of Adjusting Circular Saws to their Shafts;* Gardner R. Scriven, Philadelphia, Penna.; ante-dated May 18, 1857.

Claim.—"1st, The combination of the stationary beveled collar on the spindle with the single loose collar, having one beveled face, and the sliding pin connecting said loose collar with the saw. 2d, The plane faced collar fitting the spindle in such a manner as to be easily inclined at an angle with the spindle between two circular saws for cutting tongues and wide grooves in lumber. 3d, The sliding pin in the collar, or through the same into the fixed collar, or through the saw and into the collar, as the case may be."

110. For an *Improved Carriage Wheel;* James D. Sarven, Columbia, Tennessee.

Claim.—"The improvement in carriage wheels, which consists in the employment of flanched metallic collars, or other equivalent devices, in combination with a wooden hub, and these, in combination with the arrangement of the spokes at the hub, by which means strength and support is given both to the hub and to the spokes at or near the hub, and by which means I am enabled to use any desired number of spokes in each wheel, thereby preventing indentations being made in the rim of wheel between the spokes, and by which means I am enabled to use a much smaller hub than those in general use, and at the same time retain a sufficient degree of strength at the hub. Also, the flanched collars, or other equivalent devices, when used in combination with a wooden hub, if the spokes are arranged as herein described, or if arranged in any other manner."

111. For an *Improved Hob for Cutting Screw Chasers;* Gottlob C. Schneider, Washington, D. C.

Claim.—"The hob for cutting the thread of screw chasers."

112. For an *Improved Nail Machine;* Elhanan W. Scott, Lowell, Massachusetts, and Ammi M. George, Nashua, New Hampshire.

Claim.—"Forcing the pointing rolls to revolve and advance at the same time to point the nails or spikes."

113. For an *Improvement in the Manufacture of Boots;* James Scrimgeour, Brooklyn, New York.

Claim.—"The cutting out or otherwise forming a piece of leather or other material to the shape, and the folding of the same to produce the 'upper' of a boot."

114. For an *Improvement in Steering Apparatus for Ships;* Phineas Smith, Patchague, New York.

Claim.—"The arrangement of the movable cogs, plate, pinion, and ropes, for operating the tiller by the steering wheel."

115. For an *Improved Paper File;* D. A. Stiles, West Meriden, Connecticut.

Claim.—"The combination of the double self-acting spring catch with the top or follower."

116. For an *Improvement in Mop-Head;* Edward P. Thompson, Worcester, Mass.

Claim.—"The improved self-acting mop-holder, made, viz: with a spring, and two

bent legs or bars applied together, and operating in manner and in combination with a socket in the handle."

117. For an *Improved Stump Extractor;* Peter Traxler, Scottsburgh, New York.

Claim.—"The combination of the three bars with the slotted beam and lever, said beam being free to revolve. I am aware of the construction of the lever of Lagrouse, and several modifications thereof. I do not claim the reciprocating lever thus used, but simply my combination."

118. For an *Improved Road Scraper;* Hiram Van Pelt, Bath, New York.

Claim.—"The alternate arrangement of the scoops, in combination with the draft rods."

119. For an *Improvement in Gas Burners;* John C. Walsh, Lockport, New York.

Claim.—"The arrangement within the burner of two or more hollow pillars, extending up in the chambers of the burner, with holes made obliquely into the upper end of said pillars for producing counter currents of gas as it flows through the burner, to break its force and regulate the supply of gas to the tip of the burner."

120. For an *Improved Wrench;* Edward J. Worcester, Worcester, Massachusetts.

Claim.—"My improved adjustable fork jaw wrench, as made with its jaws arranged and applied to its handle, and applied to the side of the movable jaw."

121. For an *Improved Machine for Setting Tires on Wheels;* John H. Williams, Pleasant Hill, Ohio.

"The invention relates to the peculiar construction of an apparatus which serves to retain the wheel of a vehicle in a true position during a process of setting the tire on said wheel, preventing said wheel from dishing, and which apparatus affords the means of placing the wheel easily in a horizontal or vertical position, as the operator may require."

Claim.—"Hanging the frame to which the wheel is secured to a revolving shaft, so that the wheel may be turned up into a horizontal position for the facility of working at it, and then into a vertical position to bring the perimeter of the wheel into the water trough."

122. For an *Improvement in Damper Regulator for Steam Boilers;* Patrick White, Brooklyn, New York.

Claim.—"Securing the ends of the flexible tube by the clamps and metallic plugs."

123. For an *Improved Nut Machine;* Samuel H. Whitaker, Cincinnati, Ohio.

Claim.—"1st, The employment of a taper punch, a hollow plunger, or its equivalent, and a taper pointed mandrel. 2d, The combination of the hollow sleeve and the plunger and cutter, with the forming rollers, for the purpose of carrying the nut or washer blanks to and from the said roller."

124. For an *Improvement in Machines for Folding Paper;* James F. Weeks, Columbus, Ohio.

Claim.—"The manner of operating the feed rollers and folders by means of friction rollers, or their equivalents, revolving upon the plane of a wheel or wheels, striking against fingers or tripping arms, or their equivalents, keyed upon the rock shafts to which the feed roller and folders are attached, in combination with spiral springs upon said rock shafts, to return the feed roller and folders to their places, the whole tending to facilitate the rapid, easy, and certain operation of the machine. Also, making slots in said wheel or wheels in which to fasten said friction rollers, or their equivalents, at any desired point, by means of the thimble, bolt, and nut, constituting the movable stud, so that said friction rollers may be moved forwards or backwards to cause the motion of said rock shafts, spiral springs, rollers, and tapes, for the purpose of forming any desired folds in paper, using any number of said slotted wheels, friction rollers, rock shafts, spiral springs, rollers, and tapes, or their equivalents, in combination, necessary for the purpose of producing any number or form of fold required."

125. For an *Improvement in Cheese Hoops;* C. P. S. Wardwell, Lake Village, New Hampshire.

"The invention consists in providing cheese hoops that are constructed with an open-

ing in one side, with a fastening that shall firmly close the hoop or force it open whenever desired during the process of forming cheese."

Claim.—"The combination of the hasp having a bridge or bar at the outer end of its slot, with the oblong button, the two operating together."

126. For *Improved Automatic Saw-Mill Blocks;* Hiram Wells, Florence, Mass.

Claim.—"The devices, or their equivalents, so constructed as to traverse the log towards the saw simultaneously on each head block, and set it automatically, or permit the workman to set the log on either head block, or on all at the same time, by the lever when put in gear with the rack."

127. For an *Improved Method of Incasing Hydrants;* Wm. Barnwell, City of New York, Assignor to Samuel P. Ayres, New Rochelle, New York.

Claim.—"The casing or pipe with its seat and elastic washer, in combination with the hydrant pipe and screws."

128. For an *Improved Valvular Arrangement for Basin, &c., Cocks;* Edward P. Burnham, Assignor to self and Henry A. Chapin, Springfield, Massachusetts.

Claim.—"The new manufacture of basin, cock, or faucet, as made with a turning bib or nozzle, a sliding valve, and a tubular stem."

129. For an *Improvement in Fire Grates or Linings for Fire Pots;* Daniel H. Dean, Lowell, Assignor to Wm. T. Coggeshall, Fall River, Massachusetts.

Claim.—"Arranging the inner surface of each ring of the fire pot cylindrically or vertically, the edges of the rings inclining inwards in such manner as to bring the upper edge of one ring on or about on a level with the lower edge of the ring directly over it, whereby advantages may be gained."

130. For an *Improved Tonguing and Grooving Hand Plane;* Porter A. Gladwin, Assignor to self and Thomas F. Caldicott, Boston, Massachusetts.

Claim.—"The tonguing and grooving cutter or cutters in a single throat, and to slant in one direction, in combination with arranging the vertical guides so that one can stand below the other and the horizontal tongue guides."

131. For an *Improved Machine for Forging Horse Shoe Nails;* Robert Cook, Assignor to self and Samuel Norton, South Abington, Massachusetts.

Claim.—"Arranging each striker in a separate guide lever, and operating such striker by a spring and such guide lever. Also, combining with the pitman and the lever, carrying the feeder, a catch lever, shoulder, and spring catch, whereby the said feeder may be moved and held up to the cutters, and set free therefrom, as circumstances may require."

132. For an *Improvement in Power Printing Presses;* Jedediah Morse, Canton, Assignor to The S. P. Ruggles' Power Press Manufacturing Company, Boston, Massachusetts.

Claim.—"The combination and arrangement of mechanism or devices for supporting the sheet of paper over the carrier or frisket carriage, and guiding and presenting it to the discharging apparatus, such devices consisting of the cords, the rollers, the drum, cord, and the barrel or pulley provided with a spring, or its equivalent. Also, the combination of the cam and stud, with the rocker toggle, and its operating cam. Also, the combination for regulating the rotary motion of the ink fountain rollers, the same consisting of the adjustable stop lever, the connecting rod, the cam, the lever, the weighted plate, and the pawl, and the internal ratchet. Also, combining with the pile platform and the fly, a mechanism which by the reciprocating movements of the fly, shall lower the platform in correspondence with the increase of thickness of the pile, such mechanism being the cam on the fly-shaft, the pawl thereof, and the train of gears and racks applied. Also, the mechanism or combination for imparting to the ink cylinder endwise motions, the same consisting of the grooved pinions or gear, and the inclined gear, constructed, arranged, and applied together."

133. For an *Improvement in Machines for Pegging Boots and Shoes;* Benjamin F. Sturtevant, Assignor to self and Elmer Townsend, Boston, Mass.

Claim.—"In combination with the feeder wheel and its rotary mechanism, a mechanism for imparting to said feeder wheel, and the last reciprocating intermittent endwise movements, whereby the pegging of two ranges of pegs may be effected. Also,

constructing the feed wheel with two series of radial holes arranged in it. Also, the stop lever and its locking slide, in combination with the peg wood feeding mechanism, and made to operate therewith. Also, the tubular peg carrier, when provided with a cutter for separating the peg from the peg wood, and when arranged and made to operate with the peg wood feeder, and the feeder. Also, the combination of mechanism for producing a reciprocating intermittent endwise movement of the feeder wheel, the same consisting of the slider, the stud, the groove, the spring, the pin, the inclined cam, the pin, the tripping clitch, the lever, and slide rest, the whole being applied together. Also, combining with the mechanism for producing the reciprocating endwise movement of the feeder, a weighted arm, or its equivalent, applied to the pegging jack, whereby the shoe and last are maintained in close contact with the feeder, and permitted to move in correspondence therewith. Also, the method of effecting the feeding of the peg wood, that is, by the slider of the peg carrier, the lever, the serrated feeder, and the spring operating together."

134. For an *Improvement in Carpet Bags;* Joseph Zepfel, Assignor to self and John B. Radley, City of New York.

Claim.—"Attaching the half pieces of the divided bottom to the lower corners of the respective frames at right angles, or nearly, to said frames, whereby said bottom and frames support the flexible material of which the bag is composed, whether the same is open or shut."

135. For an *Improvement in Brick Presses;* R. R. Harbour, Oskaloosa, Iowa.

Claim.—"The employment, in combination with the wheel, of the two sets of levers, and arranged eccentrically within a circle, and on a revolving circle plate, and connected with the tops of the moulds of said plate, and with the followers of the same."

JUNE 16.

136. For an *Improvement in Mould-Boards for Reversible Ploughs;* Henry S. Akins, Berkshire, New York.

Claim.—"Providing a reversible plough with a mould-board susceptible of torsion, or of being twisted to the right and left, by means of being composed of a series of rods or bars of any desired number, so constructed and arranged with the other parts of the plough, that they can be placed and held alternately in the different positions and directions required for turning alternate right and left furrows."

137. For an *Improvement in Brine Evaporators;* Charles W. Atkinson, Henderson, Kentucky.

Claim.—"Combining a series of horizontal heating tubes with a vertical flue or chimney, when said flue or chimney is combined with an inclosing vertical casing, which has an enlargement at its upper end, entirely above the uppermost of the said heating tubes."

138. For an *Improvement in Card Printing Presses;* Franklin L. Bailey, Boston, Massachusetts.

Claim.—"Applying the guides to the bed so that they may spring or move away from and towards it, and thus not only relieve the card from contact with, and friction against, the surface of the bed, while such card is descending in the guides, but also to operate the knife and allow it to move backward. Also, arranging the guides so as to incline backward from the vertical plane, the same being for the purpose of supporting the card, and enabling the guides to be used without any front lips. Also, the combination of the spring card holder with the card rest or stop, and the feeding guides or mechanism, and the bed and platen, the said car holder being applied to the stop. Also, applying the feed and pressure rollers in a rocker frame, combined with the vibrating frame, and provided with adjustments arranged so as to enable the rocker frame to be tipped a little as occasion may require, to cause the continuous sheet of paper or card board to operate properly with respect to the position of the form on the platen. Also, arranging on the shaft, and so as to operate with a stationary roller, and with the feeding roller, a spring pressure roller to act against the edge of the sheet of card, so as to maintain its opposite edge in a proper position with respect to the type."

139. For an *Improvement in Laths for Buildings;* John L. Brabyn, City of New York.

Claim.—"The forming of the interstices in the form of a dove-tail, or its equivalent,

and the back support for the mortar in the laths themselves, and entirely independent of any thing that may be placed behind them, by grooving one or both edges of the lath on one side, and leaving the other side of the full width, so that when the same are in place, their edges shall join at the back side to prevent the plastering material from pressing through between the laths, the grooves forming the clinches to hold the mortar firmly in place."

140. For an *Improved Safety Attachment for Hatchways;* James Bridge, Augusta, Maine.

Claim.—"The guards or fenders attached to the arbors, which are secured to the underside of the doors, and connected with the flooring by the chains, the above parts being used in connexion with the inclined flanches and springs."

141. For an *Improved Hydrant;* Joel Bryant, Brooklyn, New York.

Claim.—"The invention and use of hydrants and water pipes with two main cylinders, and a cylindrical bottom part with openings, operating in connexion with each other for the admission and discharge of water."

142. For an *Improved Stock for Bench Planes;* Joel Bryant, Brooklyn, New York.

Claim.—"The construction and use of bench planes, having an opening with a backward inclination made by the dispensing with, or the removal of, the lower edge or lip of the plane stock (as existing in bench planes of ordinary construction), the said opening being made for the purpose of avoiding the annoyance produced by splinters or small pieces of wood fastening into the recess, as formed by the said lower edge or lip of the plane stock and the bevel of the plane iron in common bench planes."

143. For an *Improved Rigid Hoop Knife for Splitting Leather;* Dexter H. Chamlain, West Roxbury, Massachusetts.

Claim.—"The rigid and beveled hoop knife."

144. For an *Improvement in Harvesters;* Nicholas Clute, Dunnsville, New York.

Claim.—"The racking apparatus consisting of the endless belt, carrying arms, or rakes, when used in combination with the endless clearing apron, curved and elevated platform."

145. For an *Improved Cork Machine;* Edward Conroy, South Boston, Mass.

Claim.—"The expanding cutters attached to the rods or bars, and operated by the plate attached to the rod, the rods having pins passing through their upper ends, which pins are allowed to slide laterally in their recesses, as the rods are actuated by the plate. Also, in combination with the cutters, the cams, and bed, for feeding the stuff to the cutters."

146. For an *Improvement in the Roller Temple for Looms;* Warren W. Dutcher, Milford, Massachusetts.

Claim.—"The improved roller temple case, made with a cylindrical recess for the reception and protection of one head or end of the toothed roller."

147. For an *Improved Machine for Making Axe Polls;* Richard H. Cole, St. Louis, Missouri.

Claim.—"1st, Constructing a die box of three permanent and three movable sides. 2d, Arranging the vertically acting cutter, and the projecting portions of the sections of the die box, or their equivalents, in such a manner in relation to the other parts of the machine, that the said enumerated parts will operate substantially as described. 3d, Combining the oval punches with the opposite movable sections of the die box, when the said die box is furnished with a sharp edged side, which acts in conjunction with the said oval punches, in converting a rectangular shaped blank into a properly shaped axe poll. 4th, Cutting a rectangular shaped solid blank from the end of a bar, and then driving said blank into a die box, and converting it into a properly shaped axe poll."

148. For an *Improvement in Invalid Bed Elevators;* D. Stringham Dunning, City of New York.

Claim.—"The jointed bars connected by the cross-pieces, the cranes attached to the upright, the winches formed of the sliding pulleys and gear, the ropes or chains attached to the pulleys and cross-pieces of the bars, the whole being combined."

149. For an *Improvement in Steam Pressure Gauges;* Joseph L. Eastman, Boston, Massachusetts.

Claim.—"The arrangement of diaphragm disk bearing against the diaphragm, multiplying lever, compensating spring, and index."

150. For an *Improvement in Making Cast Iron Malleable;* A. K. Eaton, City of New York.

Claim.—"The employment of the oxide of zinc in the production of malleable iron castings, so that the articles whilst under this treatment will have continually presented to them a fresh supply of decarbonizing material."

151. For an *Improved Depilating Compound for Hides;* A. K. Eaton, City of New York.

Claim.—"The depilating process consisting in the employment of the ingredients."

152. For an *Improved Screw Cutter;* James M. Evarts, Westville, Connecticut.

Claim.—"The rotary dies placed within sliding or adjustable plates or sockets attached to the chuck, or an equivalent device."

153. For an *Improvement in Butter Workers;* Charles W. Gage, Homer, New York.

Claim.—"The combination of rollers with scrapers."

154. For an *Improvement in Motion for Preserving Rolling Contact, &c.;* George P. Gordon and Frederick O. Degener, City of New York.

Claim.—"Supporting or hanging a reciprocating bed or plate upon supports placed obliquely or out of parallel with each other, so that the face of such bed or plate shall, as it is moved back and forth, work in contact with the periphery of a cylinder, or with a fixed point or line, or act intermittently against a swinging bed or plate."

155. For an *Improvement in Corn Planters;* Ives W. McGaffey, Buffalo, N. York.

Claim.—"Hanging the swinging frame by boxes upon fixed sleeve boxes, arranged round, but distinct from, the axle, to ensure freedom of the axle against resistance encountered by the ploughs, without in the swinging of the frame varying the relative concentric position of the axle and seed distributing devices thereon, to the seed boxes."

156. For an *Improvement in Chairs for Invalids;* James G. Holmes, Charleston, South Carolina.

Claim.—"The arranging of the joint by which the seat and back are attached and moved, so that it shall correspond with the hip joint of the human frame, that is, placing it above the seat and in advance of the back. Also, arranging the knee joint in the chair or seat to correspond with that of the human knee joint of the person occupying it. Also, the frame work of metal or other material, by which all the joints and pivots, excepting that of the separate apron which moves with and supports the leg from the knee down, are combined either with or without the arm rest, as may be desired."

157. For an *Improvement in Seed Planters;* Solomon T. Holly, Rockford, Illinois.

"The invention consists in the employment or use of an indicator, whereby the dropping of the seed is indicated, and also the spots or places where it is dropped."

Claim.—"The employment or use of the indicator connected with the valve."

158. For an *Improvement in Bedsteads;* Peter Hinds, Kendall's Mills, Maine.

Claim.—"My improved turn-up bedstead, constructed with two sets of sockets in its bed posts, and with movable or secondary posts provided with connecting lines or bands, by which when the bed is turned up into a vertical position, the bedding may be maintained in place thereon."

159. For an *Improvement in Animal Traps;* Henry Hackman, Jr., Pequea, Pa.

Claim.—"The combination of the self-acting spring board with the platform, horizontal spring, and lever, constructed for the purpose of assisting in throwing off the animal as the platform tilts."

160. For an *Improvement in Sewing Machines;* Daniel Harris, Boston, Mass.

Claim.—"The arrangement of the mechanism for operating the reciprocating looper, and giving it rotation or partial rotation; that is to say, the combination of the inclined

slot plate, the pin, and the stud, or their equivalents, they operating to produce the proper movements of the looper."

161. For an *Improvement in Rudders;* Robert S. Harris, Galena, Illinois.

Claim.—"The application of an outer or second rudder attached to and working on the common rudder. Also, the short tiller held and worked by stationary chains or ropes."

162. For an *Improvement in Safety Pockets;* Horace Harris, Newark, N. J.

Claim.—"The wire frame with the spring for throwing it open."

163. For an *Improvement in the Construction of Gas Generators;* Augustus A. Hayes, Boston, Massachusetts.

Claim.—"My improved gas retort or generator, that is, with only one chamber, and with a compression conduit arranged wholly or partially outside of the chamber of the retort, and so as to pass directly into the stand pipe, and have one entrance or opening into its front end, to be closed either by the door of the retort or by a separate small door, or its equivalent, as circumstances may require. Also, combining with the gas retort and its compression conduit, a means for diminishing the internal area of the passage of the gas through the conduit, in order to produce the amount of compression of the vapors in the chamber which may be required, according to the kind of coal or other material used, the retort by such means being adapted to the decomposition of any bituminous coal, or other gas producing material."

164. For an *Improvement in the Cutting Apparatus of Harvesters;* M. G. Hubbard, Penn Yan, New York.

Claim.—"The mode of attaching the cutters to the cutter bar."

165. For an *Improvement in Machines for Scouring and Setting Leather;* Peter E. Hummel, Pulaski, New York.

Claim.—"The revolving table or bed in connexion with the reciprocating head formed of the plate, having the frames attached in which the shafts are fitted, the shafts being provided with sockets, and adjustable counter poises."

166. For an *Improvement in Ploughs;* Charles B. Ingersoll, Morris, Illinois.

Claim.—"The standard, in combination with the standard arms and shear bar."

167. For an *Improvement in Foot Stove;* John W. Letferts, Brooklyn, New York.

Claim.—"The lamp fitted or placed within the cylindrical chamber of the box, the lamp being constructed in annular form, so as to have a passage through its centre to feed the flame with air, and the box fitted within the case, the box being provided with the perforated or reticulated plate with passages and draft pipe."

168. For an *Improvement in Ploughs;* Erasmus D. and Leander W. Legg, Speedsville, New York.

"The invention consists in so constructing side hill ploughs that the mould will revolve from side to side as may be desired, while the cutter may be moved from side to side laterally, to accommodate itself to change of the mould board."

Claim.—"The combination of the adjustable cutter and the reversible mould board."

169. For an *Improvement in Railroad Snow Excavators;* S. Y. Ludlum, Oyster Bay, New York.

Claim.—"The tilting box or scoop attached to the sliding frame, and provided with the rod or cutter, and hinge sides, one or both, the frame being attached to the truck, and the box, and rod or cutter, operated by the locomotive through the medium of the cord or chain."

170. For an *Improvement in Machines for Sowing Grain in Drills;* Frederick Moehlmann, Belleville, Illinois.

Claim.—"Having the curved slot of the upper stationary plate terminate in the form of a scroll or letter *c*, and the slot of the lower plate arranged in such relation to the same, that as the lower plate turns, the seed in order to escape, as they are forced along on a curve by spurs of the turning plate, shall be compelled to take a direction toward the axis of the plate, and thus be saved from being cracked or broken by being compressed between the terminations of the upper and lower slots."

171. For an *Improvement in Corn Planters;* Wm. T. Pepper, Rising Sun, Ind.

Claim.—"The arrangement of the flanches on the periphery of the wheel, when used in connexion with the plate, scrapers, and receiving or conducting spout, or their equivalents. Also, the rocking seed box, having its lower end held stationary during the act of planting by contact with the ground, and operated automatically by the power by which the machine is drawn forward in the described combination with the falling floors, and seed measuring and delivering mechanism, operated by means of racks, by depressing the box against the ground."

172. For an *Improvement in Valve Connexions for Steam Engines;* Benjamin L. Phillips, Providence, Rhode Island.

Claim.—"Interposing the jointed bars or rods to be operated upon by the cams, or their equivalents, between the valves and the connecting block."

173. For an *Improvement in Corn Planters;* Sylvanus Richardson, Jericho, Vermont.

Claim.—"The seed cylinder operated by spring, in combination with slide and spring valve."

174. For an *Improvement in Valve Gear of Steam Engines;* Samuel Swartz, Buffalo, New York.

Claim.—"The tappet or valve lifter upon a wheel or segment, and giving said wheel or segment a rotary motion, in combination with a reciprocating motion. Also, arresting the reciprocating motion of said wheel or segment, and commencing its rotary motion at a point where its rotary motion will cause the tappet to strike the valve-toe on a line (or nearly so) drawn through the centre of the joint, and perpendicular to the line of reciprocating motion."

175. For an *Improved Condensing Apparatus for Salt and Gases;* John C. Fr. Salomon, Baltimore, Maryland.

Claim.—"The combination of a series of blast pipes and free air or water passages, with a succession of receivers."

176. For an *Improved Postage Stamp and Label Sticker;* Coleman Sellers, Philadelphia, Pennsylvania.

Claim.—"The combination of the lips or flanches, or their equivalents, in the label holder, with the follower, or its equivalents, when said lips or said follower, or their equivalents, are made of such a form as to cause the stamps or labels to bulge out beyond the face of the stamp holder. Also, the attachment of the follower, or its equivalent, with the handle to convey the pressure directly to the stamp or labels."

177. For an *Improvement in Refrigerators;* John C. Schooley, Cincinnati, Ohio.

Claim.—"The employment of the double register and openings, in combination with the partition and openings."

178. For an *Improvement in Bending Sheet Metal Pans;* E. A. Smead, Tioga, Pennsylvania.

Claim.—"The two levers operated through the medium of the arms, which are attached to the sliding bar, the lips or jaws of the levers working over the blocks or beds."

179. For an *Improvement in Wiring Tin Pans;* E. A. Smead, Tioga, Penna.

"My invention consists in the employment or use of a segment bar and vibrating bar, in connexion with a stationary bed, and operated by a sliding bar, whereby the edges of the pan or vessel are closed around the wire in an expeditious and perfect manner."

Claim.—"The combination of the segment bar, vibrating bar, and bed, the bar being operated from the sliding bar through the medium of the link, and the bar being actuated by the beveled or inclined projections."

180. For an *Improvement in Gang Ploughs;* Joseph Sutter, St. Louis Co., Mo.

"The invention consists in placing on a quadrangular frame a series of ploughs, each one of which is to be supported on a pivot (in its 'land side'), so as to vibrate freely and to be so connected and arranged that the ploughman can regulate their dip with facility."

Claim.—"The combination of the ploughs with the frame and pivot."

181. For an *Improvement in Propeller Canal Boats;* George W. Swartz, Buffalo, New York.

Claim.—"So forming the recesses in the plates that they may protect the propeller, and give direction to the current of water moved by the propeller."

182. For an *Improved Method of Elevating Water by Compressed Air;* Archibald Thomson, Detroit, Michigan.

Claim.—"The reservoir or tank formed or provided with two compartments, which are provided respectively with valves, the compartment provided with the air forcing pipe, and eduction pipe, the two compartments by the action of the valves communicating intermittently by means of the pipe and passage."

183. For an *Improvement in Cultivator Ploughs;* Micajah Tolle, Newport, Ky.

Claim.—"The bracket, in combination with the plough beam."

184. For an *Improvement in Excavating Machines;* Alonzo Taggart, Warrenton, Missouri.

Claim.—"The free draft connexion of the scraper by chains, in combination with the balancing suspension chains, and the opposite stay chains, arranged and operating in connexion with the frame and windlass."

185. For an *Improvement in Smut Machines;* James Tompkins, Liberty, Penna.

Claim.—"Constructing machines for cleaning grain of two cylinders, one placed within the other, and of two sets of beaters secured to one shaft passing these cylinders, the whole so arranged that grain being cleansed may be subjected to two separate and distinct agitations in the one machine."

186. For an *Improvement in Mowing Machines;* Jeremy B. Wardwell, Methuen, Massachusetts.

Claim.—"Supporting the finger bar and cutting apparatus from the main shaft."

187. For an *Improvement in Means for Propelling Vessels in Shoal Water;* J. W. Wetmore, Erie, Pennsylvania.

"The invention consists in improved means of operating a propelling or locomotive wheel for the boat on the bottom of the streams."

Claim.—"The arrangement of the arms in relation to each other, and to the crank shaft and toothed wheel."

188. For an *Improvement in Gas Generators;* Ezra W. Whitehead and James L. Conklin, Newark, New Jersey.

Claim.—"The construction and arrangement of the retort, having two flues on opposite sides for strengthening the same, and leaving a larger portion of the walls of the retort for the direct action of the fire."

189. For an *Improvement in Umbrellas and Parasols;* James Willis, London, England; patented in England March 24, 1855.

Claim.—"My improved manufacture of the runner and slider, and top joint collar, as made with its notched flanch of drawn or rolled metal bent into a ring, and constructed in manner and applied thereto. Also, my improved method of confining the wire in the flanch, viz: by means of a flanch made tubular, or with a groove and space formed to admit and receive the circular split ring of a wire bent down laterally on the ring and between the spreaders or ribs, the same not only causing the wire to be grasped between each two joints of the spreaders or ribs, but providing a smooth flanch without any projections likely to tear or injure the cloth cover of the umbrella."

190. For an *Improved Machine for Skiving Boot Counters;* Wm. Butterfield, Boston, and Bradford Stetson, Uxbridge, Assignor to selves and Elmer Townsend, Boston, Massachusetts.

Claim.—"The combination and arrangement of the secondary or adjustable feed roller and skiving cutter with the driving and feeding shafts, and the primary or stationary feed rollers and skiving cutters."

191. For an *Improvement in Machines for Graduating Lineal Measures;* Samuel C. Hubbard, Assignor to Charles C. Hubbard, Middletown, Connecticut.

Claim.—"In combination with dies for imprinting the figures and transverse lines

upon the rule gravers, or points arranged and held for marking the gauge or longitudinal lines on the rule. Also, the pressure disk with one or more indentations on its periphery corresponding to the knuckles of the joints of folding rules, when this is combined with giving to the disk thus constructed, a self-acting reverse motion, to bring it back after each impression of a rule to the precise point whence it started."

192. For an *Improvement in Steam Pressure Gauges;* Joseph H. Miller and John Kailey, Assignors to selves and John Danner, Canton, Ohio.

Claim.—"The bell shaped end of the mercury tube, and the manner of fastening the gum elastic floor to the bottom of said bell shaped tube, by being clamped between the glass and the metal, thus securely protecting the mercury from air, steam, and water."

193. For an *Improvement in Gas Stoves;* Patrick Mihan, Assignor to self and Robert B. Fitts, Boston, Massachusetts.

Claim.—"Arranging an annular gas distributing tube, a perforated or wire gauze mixer, two radiators, an air space within the radiator, and air inlet spaces, the one leading air above, and the other below the surface of the mixer, this arrangement involving inclining the gas mixer and the radiator in opposite directions with respect to one another. Also, the arrangement of the secondary radiator and its discharge tube, with reference to the radiator, the open air space within the latter and the chamber, and the air and gas burning apparatus disposed at the bottom of said chamber."

194. For an *Improved Screw Wrench;* George C. Taft, Assignor to Henry W. Mason, Worcester, Massachusetts.

Claim.—"Arranging the nut between the two male screws, in connexion with applying the auxiliary female screw and its support, with reference to the handle and shank."

195. For an *Improved Portable Steam Sawing Machine;* Samuel R. Wilmot, Watertown, Conn., and Reuben G. Fairbanks, Brooklyn, New York.

"The object of our improvements is to facilitate the attachment of a portable steam sawing apparatus to the object to be sawed, and to render that attachment more secure. Also, to enable the saw to be fed with greater regularity into the wood upon which it is acting, and to facilitate the movement of the apparatus from place to place."

Claim.—"Attaching a portable steam sawing apparatus to the object to be sawed by attaching apparatus at one side of the saw only. Also, the combination of an adjustable lever clamping apparatus with the stock of a portable sawing apparatus, the several parts of the combination being constructed and combined. Also, combining the stock of a steam sawing apparatus with the mechanism for actuating the saw by means of feeding mechanism, constructed and operating so as to feed the saw into the object to be sawed while the latter remains stationary. Also, locking the saw and the mechanism swinging therewith to the stock, so that the parts of the machine may be rigidly connected with each other, so as to facilitate their removal from place to place. Also, connecting the swinging members of a portable steam sawing apparatus with the stock at a point intermediate between the pivots and extremity of the stock."

196. For an *Improvement in Ladies' Skirts;* Edward F. Woodward, Brooklyn, New York.

Claim.—"The employment of the spiral stiffener or cord for stiffening ladies' skirts, &c., together with the saturation thereof."

197. For an *Improvement in Spring Bed Bottoms;* George W. Dow, Assignor to self and Walter F. French, Lynn, Massachusetts

Claim.—"My improved spring bedstead or bed bottom as made with two series of rests or bearers, two elastic bands or belts, and a series of transverse bars or slats, arranged together and in the bed frame."

198. For an *Improvement in Preparing Liquid Rose Pink;* John W. Perry, Assignor to James W. Gates, Boston, Massachusetts.

Claim.—"The combination of the ingredients for producing a transparent liquid rose pink to be used in imitating rose wood, &c., the same consisting of potash, ground red wood, and gum shellac, and water mixed."

199. For an *Improved Keeper for Locks and Latches;* Andrew Patterson, Birmingham, Assignor to J. H. Jones, Pittsburgh, Pennsylvania.

Claim.—"The use and employment, in combination with a blunt or round end latch

bolt, in a double faced or reversible lock case, of a keeper, the face of which is curved or made concave."

200. For an *Improvement in Knitted Fabrics;* Joseph Vickerstaff, Assignor to Martin Landenberger, Philadelphia, Pennsylvania.

Claim.—"A fabric knitted with threads of different colors, and composed of two separate thicknesses interlocked during the process of knitting at any required intervals, by transposing the threads in such a manner that a knitted fabric may be produced both sides of which shall present a plain uninterrupted surface of loops, and free from the loose unknitted threads common to other ornamental knitted fabrics."

201. For an *Improved Ventilating Vault and Platform Light;* John C. Wolvin, Assignor to self and George Peckham, City of New York.

Claim.—"The manner of securing the glass sections in place by the combined operation of the rebate and clamping plate. Also, the groove in the flanch on which the glass rests, to retain a cord of india-rubber or other elastic material or cement, and make a tight joint with the glass. Also, the gutter formed at the centre of the radial bars, in combination with the perforated clamping plate and pipe."

202. For an *Improved Faucet;* David N. B. Coffin, Jr., Newton Centre, Massachusetts, Assignor to the Boston Faucet Company.

Claim.—"The combination of the annular lifter or lifters, guide, and pin, with or without the top incline for closing the valve. Also, pivoting the annular lifter or lifters."

JUNE 23.

203. For an *Improvement in Gas Generators;* Napoleon Aubin, Albany, New York.

Claim.—"The use of a charger."

204. For an *Improvement in Printing Presses;* Franklin L. Bailey, Boston, Mass.

Claim.—"The combination and arrangement of the nipper and holding springs applied to the sheet carrier, and made to operate therewith, and whether said springs be made stationary or adjustable laterally on their shaft. I do not claim a sliding platen or plate moving out from beneath the type form, for the purpose of receiving a sheet to be printed, but I claim the combination of the sheet carrier or plate, with ways placed on the platen or vibrating frame on which it slides, so that it may assume the positions for receiving the sheet to be printed, and also for giving the impression to the same."

205. For an *Improvement in Means for Reducing Top-sails;* Thomas Batty, Brooklyn, New York.

Claim.—"1st, The arrangement of one or more bunt pennants, connected with the front of the sail, passing up the front thereof, and connected with the yard, and of a crane neck piece, or its equivalent, attached to the yard to work up and down said pennant or pennants, so that in lowering the yard the wind may be expelled from the bunt of the sail towards the sides. 2d, The arrangement of the flat blocks through which the reef pennants run on the top of the yard."

206. For an *Improvement in Machines for Polishing Raw Hide Whips;* Eugene Blattner, Philadelphia, Pennsylvania.

Claim.—"The grinding pulley and spindles, when a simultaneous rotary motion is imparted to the same, and when they are arranged for joint operation."

207. For an *Improved Method of Holding and Adjusting Plane Irons in their Stocks;* Willard W. Chipman, Lowell, Massachusetts.

Claim.—"The use and application of the apparatus for holding and adjusting the plane iron."

208. For an *Improvement in Grinding Mill;* Ezra Coleman, Philadelphia, Penna.

Claim.—"Having the concave of a cob cutter adjusted in a circular line concentric with its axis, and relatively to the mouth of the feed hopper, so that it may be set to grind faster or slower. Also, the means for insuring the rotation of the cob cutter with the grinder, and its retention in proper place when the grinder is adjusted longitudinally."

209. For an *Improved Saw-Set;* Jacob Erdle, West Bloomfield, New York.

"The invention consists in the peculiar means employed for feeding the teeth of the

saw to the punch, whereby the teeth may be fed to the punch in either direction, and in a very simple and efficient manner."

Claim.—"The two plates or hands when connected to the bar, the bar being actuated by the lever for the purpose of feeding the saw teeth to the punch in either direction."

210. For an *Improvement in Fastening Handles to Baskets;* Anthony Faas, Philadelphia, Pennsylvania.

Claim.—"An improvement in basket handles."

211. For an *Improvement in Vapor Burners;* Horatio Fairbanks, South Brookfield, Massachusetts.

Claim.—"An improved hydro-carbon vapor burner, as constructed with a secondary burner, pipe, recess, and a closing slide arranged to rotate on the body of the burner concentrically therewith, and constructed so as to be capable of either entirely or partially closing the recess, so that air may be excluded more or less from the same, and heat be confined therein, when the said recess is provided with a secondary jet or burner to operate therein."

212. For an *Improvement in Vane Governor for Steam Engines, &c.;* Francis Gustine, Medford, Massachusetts.

Claim.—"The disks or vanes operating directly upon the valve rod toes, whereby the valve is actuated by the varying deflexions of the vanes."

213. For an *Improved Valvular Arrangement for Faucets, &c.;* Edward Hamilton, Chicago, Illinois.

Claim.—"The employment of a hollow conical perforated valve."

214. For an *Improvement in Pumps;* William H. Harrison, Philadelphia, Penna.

Claim.—"The combination of the chamber, barrels, and valved buckets, and rock shaft, lever, and rods, when the whole are arranged and constructed for joint operations."

215. For an *Improvement in Picker Sawing Machines;* John Haw, Old Church, Virginia.

Claim.—"The over-hanging of the saw between braced guides, and the space beween which is adjustable by wedges and slotted braces."

216. For an *Improved Mode of Constructing Stores;* Wm. L. Johnson, Peytonsville, Tennessee.

Claim.—"Constructing the fronts with rails corresponding to those on the floor, and hinged or pivoted thereto for the purpose of throwing down the said fronts in the plane of the floor, and forming a continuous road or track on which the trucks containing the counters, goods, &c., may be readily run out or clear of the building."

217. For an *Improvement in the Manufacture of Iron;* William Kelley, Lyon County, Kentucky.

Claim.—"Blowing blasts of air, either hot or cold, up and through a mass of liquid iron, the oxygen in the air combining with the carbon in the iron, causing a greatly increased heat and boiling commotion in the fluid mass, and decarbonizing and refining the iron."

218. For an *Improved Sawing Mill;* James G. Kennedy, Cincinnati, Ohio.

Claim.—"The arrangements of the several parts of machinery and saw employed in one frame, by which I am enabled to change and run the saw carriage in either direction for sawing both ways, or if desired, saw in one direction, and run the carriage back as usual in the other direction, without sawing at all."

219. For an *Improved Device for Feeding and Limiting the Depth of Hole in Boring Machines;* Levi B. Lloyd, Warwick Township, Penna.

Claim.—"The combination of spring draw, rod, and table."

220. For *Improved Machines for Finishing Brush Handles;* Thomas Mitchell, Lansingburgh, New York.

Claim.—"The arrangement and combination of mechanical devices constituting a machine to be used for the purposes, viz: platform with revolving cutters, crown saw, with the arms and the adjustable platform and cutter wheels, with ther cutters."

221. For an *Improved Hydrant;* George P. Perrini and James E. Boyle, Richmond, Virginia.

Claim.—"The hollow piston rod and nozzle, when so constructed and arranged, in combination with cylinders of unequal diameters, and their corresponding pistons or plungers, that they will be elevated by the pressure of the water from the supply pipe upon the under surface of the piston, and the water withdrawn therefrom."

222. For an *Improvement in Ships' Windlasses;* Joseph Pevey and Abraham Sanborn, Bangor, Maine.

Claim.—"The attachment of the pawls to the slides."

223. For an *Improved Machine for Straightening Knife Blades;* Hiram Pierce, Claremont, New Hampshire.

Claim.—"The employment in conjunction with a drop weight of self-adjusting dies."

224. For an *Improvement in Enameling Iron Pipes and Hollow Ware;* Edward Pierce, Philadelphia, Pennsylvania.

Claim.—"The enameling of the interior surfaces of pipes or cast iron ware, by placing a vitrifiable compound on the core before the core is inserted into the mould."

225. For an *Improvement in Safety Apparatus for Regulating Steam Boiler Furnaces;* Wm. Pike and Isaac R. Scott, Waltham, Massachusetts.

Claim.—"The arrangement of the bent mercury tube, with its float and the parts immediately connected therewith, and the steam pipe whereby the pressure within the boiler is indicated to the eye, the dampers are regulated to suit the pressure required, and when the pressure within the boiler becomes excessive, the fire is extinguished by the escaping steam, thereby forming a safety regulating apparatus, not requiring the supervision of the attendant."

226. For an *Improved Lantern for Lighting Street Gas;* John Reese and Charles N. Tyler, Washington, D. C.

Claim.—"The gas lighter, consisting of the sliding shade, spring and guard."

227. For an *Improved Central Draft Joint of Carriages;* Luther O. Rice, Caistorville, Canada West.

Claim.—"The central draft joint."

228. For an *Improvement in Hardening Axes, &c.;* James N. Rockwell, Napanock, New York.

Claim.—"Providing the box or holder in which the axe is placed with one or more valves."

229. For an *Improvement in Candlesticks;* Timothy Rose, Courtlandville, N. Y.

Claim.—"1st, Making the socket of the candlestick, and the sliding cup within it, of greater diameter than the candle intended to be used therein. 2d, The spur in the bottom of the cup combined with the stays on the inside of the top rim, for the purpose of holding the candle in proper position, leaving space around it for the melted tallow to pass down into the cup."

230. For an *Improvement in Boring Mills;* Wm. Sellers, Philadelphia, Penna.

Claim.—"Revolving the face plate of boring or turning mills in a support, as near as convenient to the periphery thereof. Also, the adjustable step or centre bearing when this is combined with an outer support."

231. For *Improved Breech Loading Fire Arms;* John Schenkl, Boston, Mass.

Claim.—"1st, The method of stopping the hammer at half cock, by the pressure of the thumb. 2d, The bar, constructed and operated by the pin and lever, for the purpose of cocking the gun, and of returning the barrel into line with the thimble, and locking it therewith."

232. For an *Improved Mode of Securing and Adjusting Plane Irons in their Stocks;* William Stoddard, Lowell, Massachusetts.

Claim.—"The grooved stand double-headed bolt, in combination with the cam and its stand."

233. For an *Improvement in Machines for Cleaning Rice;* John F. Taylor, Charleston, South Carolina.

"The invention consists in giving a necessary movement to a body or mass of rice, placed within a proper shaped vessel, by means of a screw cylinder and guiding or deflecting plate, placed at the bottom of the vessel, the whole being so arranged that the kernels or grains of rice, are made to rub against each other, so that they will be thoroughly deprived of the flour by the attrition produced thereby, and the grain prevented from being bruised or broken."

Claim.—"The screw and cylinder, placed on the rotating shaft, in combination with the spiral projections or ledges formed on the plate, and placed at the bottom of the vessel, the whole being arranged so as to operate conjointly."

234. For an *Improvement in Caligraphs;* Charles Thurber, Worcester, Mass.

Claim.—"Combining a stylus or tracer with a pen or marker, by means of levers of different lengths connected by jointed rods, that the pen or marker may follow accurately but on a reduced scale, all the movements imparted to the stylus or tracer, in combination with the connexion of this mechanism with a desk or table, by means of an universal joint, to give freedom of motion in all directions to the stylus or tracer, and to the pen or marker, whereby a person can write the usual sized characters by tracing characters of a large size. Also, the stylus or tracer, and the pen or marker, combined with the apparatus, or its equivalents, for shifting the paper, whereby the paper is shifted to the distance equal to the space between two lines, by carrying back the stylus or tracer preparatory to tracing another line."

235. For an *Improvement in Steam Boilers;* Harry Whitaker, Buffalo, New York.

"This invention relates to a certain form and arrangement of the grate, and to certain arrangements of water spaces, fire chambers, and fire tubes, for the purpose of obtaining a very great amount of heating surface with a small body of water, yet providing for the proper circulation of the water, so that no highly heated part of the boiler shall be left uncovered by water."

Claim.—"The arrangement in an upright cylindrical boiler of an annular fire chamber, a series of descending fire tubes, a smoke box, and a series of ascending fire tubes, to convey the products of combustion from an external fire through the centre of the boiler."

236. For an *Improvement in Preparing Elastic India Rubber Cloth;* Charles Winslow, Lynn, Massachusetts.

Claim.—"The method of preparing elastic cloth for use, by the application thereto, of parallel lines in the direction of the shortest diagonal of the meshes formed by the threads of the cloth."

237. For an *Improved Machine for Excavating Tunnels;* Charles Wilson, Springfield, Massachusetts.

"The particular object of my machine is to excavate and bore tunnels through earths or rocks, and particularly through the latter, to which it is especially adapted."

Claim.—"1st, Forming grooves in stone or other mineral substance by means of rolling disk cutters on axes set in alternate opposite directions. 2d, Arranging a series of rolling disk cutters, revolving in such a manner as to cut a deep annular groove into the rock. 3d, The arrangement of the scoops and buckets, in combination with the cylindrical wheel and rotary cutters, to free the annular groove of the chips and dirt abraded by said cutters. 4th, A bed plate secured in place by the jack-screws, or their equivalents, in combination with a sliding frame, or its equivalent, projected forward as the cutting progresses by means of a screw acting between the fixed and moving parts."

238. For a *Back Ground for Photographs on Glass;* J. W. Wykes, Wheeling, Va.

"The object of my invention is with a single picture to produce the rounded and life-like image, and stereoscopic pictures."

Claim.—"The application of the enamel to collodion and albumen pictures on glass."

239. For an *Improved Method of Attaching Air Chambers to Pumps;* Charles N. Lewis, Assignor to George C. King, Seneca Falls, New York.

Claim.—"Connecting the air chamber with the cylinder by means of the stuffing-box and follower, applied to the pump and arranged relatively with the several parts."

240. For an *Improved Water Metre;* Peter H. Niles, Assignor to self and Alfred Douglass, Jr., Boston, Massachusetts.

Claim.—"1st, The two pistons operating in a single cylinder, in combination with the differential piston. 2d, The air chamber between the pistons. 3d, The float valve in combinaton with the two-way cock, whereby when the water is shut off, all the chambers of the metre are emptied."

241. For *Improved Taps and Dies for Cutting Screws;* Ira A. Richards, Assignor to Silas Stevens, East Brookfield, Massachusetts.

Claim.—"1st, Cutting away the teeth of taps and dies on one side. 2d, Making the opposite scores which are parallel with the slides in which the two parts of a die work, or at right angles to the partition of the die, both on the same side of the line drawn through the centre of the die."

242. For an *Improvement in Steam Whistles;* Sylvester W. Warren, Assignor to self and Dexter N. Force, Brooklyn (E. D.), New York.

Claim.—"The cap and whistling mouth or mouths, connected to the steam pipe. Also, placing two or more whistling mouths or edges in the whistle at different distances from the orifices for the escape of steam, so as to adapt one whistle to different pressures, without changing the position of any of the parts."

243. For an *Improved Bench Plane;* Thomas D. Worrall, Lowell, Assignor to Thomas F. Caldicott, Charlestown, Massachusetts.

Claim.—"The improved manufacture of carpenters' bench plane or jointer, as made with its handle, its wooden stock, to which said handle is affixed, and a separate metallic cutter holder and cutter clamping devices."

244. For an *Improvement in Cylindrical Throttle Valves for Steam Engines;* James H. Simmons, Erwin, New York.

Claim.—"The arrangement of the latch upon the stem of the valve playing in the recess within the interior of the head of the cylinder."

245. For an *Improved Breech Loading Fire Arm;* Gilbert Smith, Buttermilk Falls, New York.

Claim.—"Making the chamber to receive the charge in the form of a cartridge partly in the barrel and partly in the breech, and so much larger than the general bore of the barrel as to have a shoulder in front to retain the cartridge case thereon till after the discharge, whereby the joint between the breech and the barrel is brought near the middle of the chamber and not in a corner at the extreme rear or in the front thereof, and is caused to be packed by the lateral expansion of an elastic cartridge case. Also, furnishing the said clamping lever with a projection so arranged as to be acted upon by the hammer in the act of cocking the latter, for the purpose of insuring locking the breech and barrel together before the discharge, and effecting the operations of cocking the hammer, and locking the breech and barrel, by one movement. Also, the sight, constructed with a round stem flattened on one side, and having a spring applied to it for the purpose of enabling it to be adjusted and secured at various elevations."

MECHANICS, PHYSICS, AND CHEMISTRY.

*On Soluble Glass, its Preparation and Applications.**

By J. N. von Fuchs.

(Continued from page 125.)

To the porous bodies by which soluble glass is imbibed it communicates an extraordinary solidity. In this category are included almost all objects of burnt clay, such as bricks, tiles, furnace-tiles, pottery, &c., as well as loose limestones and sand-stones, and wood-work.

* From the Lond. Chem. Gaz., No. 347.

The material which is especially applicable to technical purposes in combination with soluble glass, is—

a. Carbonate of lime (chalk, calcareous sand, powdered marble).—When powdered chalk is made into a paste with water, well dried and soaked with soluble glass, it furnishes a very compact mass. According to Buchner, if a fragment of chalk be immersed in moderately concentrated soluble glass, and left in it for about two days, then taken out, dried, and again laid in a more dilute soluble glass for a time, it is completely penetrated by the glass, and when dried, acquires a hardness throughout which approaches very closely to that of marble: it receives a good polish, and does not soften in the least in water, which only acquires a weak alkaline reaction from it. It has also acquired a considerable density. Von Liebig and Buchner have very recently convinced themselves of this remarkable behavior of soluble glass by their own experiments. Chalk consequently furnishes an excellent addition to soluble glass, to bind it firmly and render it insoluble in water.

b. Dolomite appears, from experiments very recently made with it, to excel even limestone in its binding power; and as it is distinctly harder than limestone, the mass prepared with its powder acquires even by this means a greater power of resistance to external actions, both mechanical and chemical. At any rate, it is one of the best means of binding soluble glass, and rendering it insoluble in water; and as it occurs very abundantly in nature, and is widely diffused, it may be obtained almost everywhere without any great expense.

c. Phosphate of Lime (Bone-earth).—Phosphate of lime also furnishes a very compact mass with soluble glass; this hardly differs from that formed with carbonate of lime, although no chemical action or conversion of the constituents takes place.

d. Caustic lime.—When triturated with slaked lime, soluble glass quickly stiffens, and then dries slowly into a tolerably hard mass. In this case a chemical combination of the lime with the glass takes place, and potash is separated, when a sufficient quantity of soluble glass is present. Of course, water cannot injure this product. It may often be employed with good results as an addition to other masses which do not combine well; the addition, however, must be small, as otherwise the penetration of the soluble glass is prevented.

e. Lime disintegrated by exposure to the air (semicarbonate of lime).—This acts very well with soluble glass when triturated therewith; it does not stiffen (coagulate), and dries gradually into a solid mass, which is a chemical product consisting of silicates of potash and lime. This may be very serviceable as an addition to other masses; and as caustic lime is soon converted into semicarbonate by the action of carbonic acid in the air, walls built with lime-water may be, after some time, soaked with soluble glass, in order to give them greater solidity.

f. Powdered Quartz.—Powdered quartz, however fine it may be, exhibits no great adhesiveness with soluble glass, which could hardly have been supposed. If a mortar-like mass be made with it, and this be spread upon a tile previously soaked with soluble glass, it dries in a few days into a solid mass, which resists rain, and acquires a stony hardness on the surface. But when this surface is broken through, the interior is

found to be quite soft and destitute of soluble glass, which has concentrated itself at the surface. It can only receive a perfectly uniform consistence by frequent soaking with soluble glass.

The case is very different when the powder is first mixed with a little lime disintegrated in the air, then treated with soluble glass, and twice subsequently impregnated therewith. In this way the mixture becomes so compact as to leave scarcely anything to be desired.

The same thing takes place with lime-mortar to which quartz-sand has been added, when it is treated with soluble glass after it is thoroughly dry.

g. Burnt Clay and Porcelain Earth.—These bodies also are amongst those with which soluble glass does not combine strongly. Here also the soluble glass collects towards the surface, and leaves a loose powder in the interior, which can only be bound together by frequent additions of soluble glass.

Objects made of different kinds of clay behave very differently when they have been burnt, and, as is usually the case, are porous, so that they imbibe the soluble glass. For example, if a burnt plate of potter's clay, which possesses no great solidity, and may easily be broken, be repeatedly drenched with moderately concentrated soluble glass, and dried after each soaking, it acquires such solidity as to be capable of opposing an obstinate resistance to both chemical and mechanical forces. A plate thus prepared, made out of the so-called sagger clay, not much more than half an inch thick, and so soft that it fell to pieces at the least pressure before its impregnation with soluble glass, is employed by Professor Kaiser as a covering plate in his evaporating furnace, in which vapors of various kinds pass over it; but these have been as yet unable to injure it in a space of about twelve years. Not only plates but articles of pottery of almost all kinds may be rendered solid and durable by soluble glass, that is to say, if they imbibe it well.

h. Oxide of Zinc (Zinc-white) *and Magnesia.*—These two bodies act very energetically upon soluble glass, and here also they exhibit their analogy, which may be recognised in many other chemical combinations, both natural and artificial.

Oxide of zinc may be triturated with soluble glass without the occurrence of any stiffening. This mass, when laid rather thick upon a solid support previously soaked with soluble glass, binds together slowly, and gradually hardens, during which it acquires a great many cracks, and breaks up into numerous small hard fragments, which separate from the support; these are not diffusible in water, to which they only give a slight alkaline reaction, whilst they retain their hardness. From this we may conclude that oxide of zinc enters into an intimate chemical combination with soluble glass.

If the mixture of oxide of zinc and soluble glass be only laid thinly upon the support, it remains firmly attached to it, and furnishes a good coating, to which any color may be given at pleasure.

As this oxide possesses such a strong binding power, and its product with soluble glass presents such a complete resistance to the action of water, it is necessary to add a small quantity to those masses which do not bind sufficiently, mixing it intimately with them before the soluble

glass is added. Even with masses which bind well a small addition of oxide of zinc is not only not injurious, but advantageous, by increasing their solidity, and at all events, preventing the passage of the soluble glass to the surface.

Pure Magnesia, when triturated into a pasty mass with concentrated soluble glass, binds together more quickly than oxide of zinc, and hardens very greatly in drying; but when laid upon a solid basis to a greater thickness than card-board, it frequently cracks, and becomes for the most part loosened from its support. The fragments cracked off show considerable hardness when triturated. The water employed for this purpose has an alkaline reaction, but gives no turbidity with muriate of ammonia, proving that only a little potash is dissolved, but no silica, or at the utmost only a trace.

There is consequently no doubt that magnesia, like oxide of zinc, combines chemically with soluble glass, and like this, may be employed advantageously as an addition to other less binding masses.

With regard to the behavior of carbonate of magnesia towards soluble glass, experiments have only been made with that kind which is known under the name of *Magnesia alba;* these all gave satisfactory results. The mass, made into a paste with concentrated soluble glass, and spread upon a glass plate, soon adhered, and in a few days acquired such solidity, that it held so firmly to the glass plate as to be only separated from it with difficulty with a knife. A few fragments of it were put into water, and digested for some time, when, although the consistence of the mass was not perceptibly altered, some carbonate of potash without silica was dissolved; muriate of ammonia produced no turbidity. A portion of it was pulverized and extracted with water in which some carbonate of potash was dissolved. A portion was mixed with dilute sulphuric acid, when a slight effervescence was gradually produced, magnesia was dissolved together with the potash still present, and silica was left behind in the form of powder, which dissolved easily and completely in solution of potash.

Magnesia alba and soluble glass consequently act chemically upon one another, the silica with a portion of the potash combining with the magnesia, at the same time that some carbonate of potash is formed. *Magnesia alba* consequently is one of the most excellent fixing agents for soluble glass.

i. Gypsum (hydrated sulphate of lime).—Gypsum, when triturated with soluble glass, sets immediately, and during desiccation a large quantity of sulphate of potash or soda effloresces very soon, according as potash or soda-glass is made use of in the experiment. After drying, the mass is scarcely perceptibly firmer than ordinary plaster of Paris. A mutual chemical action takes place here unmistakeably. From this behavior it appears that objects made of plaster of Paris cannot be impregnated with soluble glass to render them more solid and stable in the air, as in consequence of the quick setting it cannot penetrate into them. As a matter of course, this body cannot be employed for the purpose under consideration; and in any operation undertaken with soluble glass and bodies to be mixed therewith, the formation of gypsum must be prevented, and still more must its presence ready formed in them be avoided.

Anhydrite (anhydrous sulphate of lime) and strongly calcined plaster, which, according to the author's opinion, approaches this very closely, promise a better result; but nothing can be stated decidedly upon this point, as the experiments commenced therewith are not yet completed. These and many other experiments with various bodies as to their behavior with soluble glass will be communicated hereafter. These bodies are, heavy spar, fluor spar, oxide of iron, basic iron salts, litharge, white-lead, &c. The bodies here referred to, with their behavior towards soluble glass, are sufficient for the present purpose.

In these experiments, as also in practice, the degree of concentration of the soluble glass employed is by no means indifferent: 1 part by measure of concentrated soluble glass to 2 parts by measure of water, should be the maximum, and 1 part by measure of the same glass to ½ part by measure of water the minimum of dilution, or sometimes a little less, according to circumstances.

If it be too much concentrated or diluted, it very often does not produce the effects required of it. If it be very concentrated, it does not penetrate easily or deeply enough into bodies which are to be impregnated with it; and if it be much diluted and made into a pasty mass with powdered bodies, these may appear sufficiently coherent at first when dried, but in a few days they are found to be more or less loose and soft, and the desired degree of solidity can only be obtained by frequent treatment with soluble glass. By the dilute soluble glass the particles of the body are kept too far apart, so that when the soluble glass contracted, innumerable small interstices are produced, which interrupt the cohesion. The question arises also, as to how far the saturation of such bodies with soluble glass is to be carried, whether until they can take up no more soluble glass, and are completely closed, or only so far that they may remain to a certain extent permeable to it. In the former case the greatest possible solidity is attained; in the latter we gain the advantage of being able subsequently to apply colors, and fix them with soluble glass. The proper proportion must remain to be ascertained by those who set about the attainment of a particular object. It only remains to be remarked, that when a body is completely saturated with soluble glass and closed by it, it may be again opened to a certain extent when it is heated, or when alcohol is burnt upon it once or twice.

In course of time the pores open somewhat of themselves, especially when they are frequently exposed to rain, by which some alkali is carried off, and the silica gradually acquires the predominance, so that at last a complete petrification is effected, and the final object of this process is attained.

Potash-glass, which hardens when intermixed with pulverulent bodies somewhat more rapidly than the soda-glass, may perhaps also give them a rather greater solidity; but the difference is by no means considerable. The soda-glass, however, at any rate possesses an advantage over the former in its greater fluidity, in consequence of which it penetrates into the smallest interstices, pores, and cracks with much more facility than the somewhat sticky and tough potash-glass. This is of some importance to masons and statuaries. As soda does not combine with silica so strongly as potash, and has a great tendency to effloresce by combining

with carbonic acid, this might perhaps give an advantage to the soda-glass, because by this means the silica is more readily set free, and the silicatization of the mass is sooner attained; this, however, must be left to further observations.

The double soluble glass seems to unite the properties of the two preceding, and may perhaps deserve a general preference over them, because it contains two basis (potash and soda) with which silica, which prefers entering into double combinations, combines more powerfully.

The soluble glass for fixing, as already stated, has its own proper purpose, but it is also applicable to many other objects, especially in painting.

The first three kinds of soluble glass, when completely saturated with silica, are always more or less turbid or opalescent; this is attributable to imperfectly dissolved and extremely finely divided silica.

To deprive them of this, which may even frequently be economical, we need only and a little silicate of soda, and let them stand for about a day, with frequent stirring. By this means the turbidity completely disappears, the fluid becomes perfectly limpid, if it be not colored by some other (organic) substance.

(To be Continued.)

For the Journal of the Franklin Institute.

On Superheated Steam. By Thomas Prosser, Civ. Eng.

The subject of superheated steam is far from being a new one, but inasmuch as another of those oft recurring efforts to which an imperfect knowledge of the physical laws which govern it is now being made, I have ventured a few *more* words of advice, in the hope of staying the delusion somewhat, to prevent a useless expenditure of time and of money, with a *fearful sacrifice of life itself*, which must inevitably result from the extensive adoption of superheated steam, produced in the manner generally contemplated.

The superheated is probably the only state in which steam should be admitted into the cylinder of a steam engine, for the purpose of fully developing its mechanical effects in the most economical manner, provided that can be done without increasing the danger which necessarily attends its use in any state.

Instead of superheated, however, the subject has been treated more like supernatural, for if the *gain* (that is the term applied) observable, when steam is so used, is really attributable to it as the primary cause, we have an effect from a cause which is in no way adequate to its production, so far at least as our knowledge of the physical nature of steam extends; the effect therefore is supernatural.

It would be no difficult task to show the delusion under which the experimenters themselves have labored, in all those cases which are relied upon to prove the enormous *gain* obtained by using superheated steam; but it would be an endless repetition. I prefer therefore to state what we do know, if any reliance is to be placed on the experiments of Regnault, and others, viz: That all dry gaseous bodies are expanded nearly alike by the absorption of the same total amount of heat, and

that there exists no reason whatever for supposing that steam acts otherwise when superheated.

There is no dogma better supported by inductive reasoning than this, as a physical fact, for although there are no experiments which entirely agree with it, the differences are so small as to be within the possible errors of experiments of so much delicacy. At all events, even the experiments themselves, however selected, do not justify the claims set up in favor of surcharged steam, hot air, carbonic acid gas, alcohol, or ether, and the failure of all of them points to the one same cause.

If steam is an exception to the general rule, we have no reliable experiments which prove it, for those which have been supposed to do so are of no value whatever.

The solution of the difficulty is simply this: superheating the steam prevents its condensation in the cylinder, and therefore avoids a loss, that is all which it can do, and enough too, for that loss is so enormous, that the advocates of the air-pump condenser are compelled almost to ignore it, or to acknowledge this new "spirit" of evil and of error. Of evil because of the extreme danger attending its production, and of error because aiming at the curing of an evil, instead of preventing its existence, for, says the good old proverb, "*prevention is better than cure.*"

When we reflect upon the fact that the air-pump which is used to exhaust receivers in the production of ice, and that the air-pump of a steam engine condenser are of precisely the same character, need we be surprised (or should we not be surprised if it were otherwise,) that a chilling effect is produced upon the inside of a cylinder at a high temperature, and ever exposed to its influence? Surely, the steam which comes in contact with the cylinder and piston must be condensed, and to some extent lose its mechanical power. That the interior (as well as the exterior) surface of the cylinder has to be warmed, is self-evident, but there is a vast difference between doing it by the condensation of the steam at a time when it should be exerting its utmost mechanical effect upon the piston, and doing it through the medium of the superheat while the steam itself is left in full power, uncondensed.

Superheated steam therefore prevents waste; but the processes by which it is generally proposed to superheat it are attended with imminent danger, not only on account of the rapid corrosion of the metal in contact with the steam while being superheated, but also on account of the great immobility of the particles of steam (when so superheated), and their low additional specific heat, which prevents absorption as fast as the metal will allow the heat to pass, and thus renders it liable to become red hot.

Now, expanding high pressure steam before admitting it into the cylinder, has precisely the same beneficial effect in preventing condensation, and is not attended with the danger of superheating; but then comes the bug-bear of *wire-drawn steam*. Now, what does it matter if the steam is throttled, provided we get all the power required from it? If *none* is condensed in the cylinder, all the power in the steam has been utilized. The dense steam will not cost more to make in proportiou to its value than any other less dense.

Steam at 200° C. has a pressure of 15·38 atmospheres, and its *total heat* amounts to 667·5° C. according to Regnault. By throttling so as to wire-draw it, as it is called, it assumes the state of *superheated* steam, in consequence of having more heat than is contained in normal steam when so expanded, while at the same time it is deficient of water or density. Supposing it has retained its original amount of *total heat* without any cooling, excepting that occasioned by expansion to four times its volume, the temperature will fall from 200° C. to about 158·3° C., while the density and pressure will be one-fourth of the original steam. Clearly this must be *superheated steam*, for normal steam has no such proportions as we have assumed between its total heat, density, and pressure. But allow this expanded steam to cool down to the point of deposition, which is about 140° C., and pressure 3·576° C., and the same authority as before quoted will inform us that the total heat in such steam is but 649·2° C., having lost 18·3° C. (=667·5—649·2) of total heat by the reduction of its temperature from 200° C. to 140° C. (=60 per cent.) This loss of total heat, which must go into the metal of the cylinder and piston before any condensation can take place, amounts to about 1-36th of the total heat contained in the steam before expansion, and is abundantly sufficient to prevent any condensation in the cylinder, working with ordinary and *further* expansion.

The mechanical effect of the expansion between the boiler and cylinder is lost, but not more so than if it had never been created, since it costs no more to produce high than low pressure steam.

The same weight of fuel will evaporate the same weight of water under all pressures, and, therefore, the hotter the water is, the more rapidly and effectually will it abstract heat from the fuel, for it really contains more of it, and as the fuel is the only source of supply, there must be greater economy in burning it under hot than cold water, and this agrees with Leslie's experiments, which show that water at the boiling point abstracts heat five times more rapidly than it does at the freezing one.

Of course the boiler must be stronger in proportion to the elasticity of the steam to be generated in it, but that need form no objection now, as the use of cast steel instead of iron will fully compensate for the difference.

Cast steel boiler plates are now being used by the English government, and it is to be hoped that this element of safety will ere long be adopted by our own, for with this material a boiler can be made which *cannot* be bursted by mere steam pressure. The author has one of iron which he thinks may claim the same immunity—at all events, he is willing to test it against any other in the United States.

Although, therefore, there are no objections to the making of this high pressure steam, there are some to the using of it, without *letting down*.

In the first place, it may blow off the cylinder cover of a good many engines such as are now built, if it did not burst the steam chest before reaching it, or even the cylinder itself.

In the second place, it may burn up hemp packing, for the tempera-

ture is greater than any cooking oven (200° C. = 392° F.), although not half so hot as air and surcharged steam has been *done at.*

Nevertheless, if high pressure steam is required in the dry state, it can be obtained with safety and simplicity from a multitubular boiler, similar to the one which supplied steam to the fire-engine exhibited in the Park some time since, which raised steam from cold water in five minutes from the time of lighting the fire in the regular safe and honest way, with the tube plate sufficiently covered by the water, and not in that extremely dangerous manner which many others do it, by first heating the metal to almost a red heat, and then projecting the water upon it.

The steam from this fire-engine boiler has moreover, after having been at work some time, left the exhaust pipe and *heater* perfectly dry.

The proportions of such a boiler as will give the required results, appear to be about 1 foot of grate to 60 or 70 feet of recipient heating surface, of which at least one-third should be above the water line, and in among the steam for the purpose of drying it through the medium of the hot gases after they have passed through the water, and have become sufficiently cooled to be used with safety for that purpose. These are equal to the best locomotive boiler proportions, but the application is very different, as the boiler is upright, and the uptake is immensely expanded just below the water line, at the instant the gases are in a state of intense ignition.

I have stated nothing in this communication but simply physical facts, and yet I know very well that a majority of engineers of the present day will condemn them as heretic, and probably knock them on the head with the sledge hammer of *practical experience.* If you are right, said one of our most eminent engineers, we are all wrong. Even so. But *truth*—ah!—*will prevail*, which I intended to prove by some poet, but having forgotton his poetry, will merely reiterate, *will prevail*, without, however, committing myself to the precise time—when.

New York, July, 1857.

Specification of a Patent granted to Henry R. Worthington, *of New York, U. S., for a machine for measuring the flow of Liquids, called a metre.*—[Dated 16th of January, 1856.]

This invention of improvements in metres for measuring fluids relates to that description of metres which have a reciprocating action, and where the cylinder is alternately filled and emptied; at the same time registering the number of strokes of the piston, which indicates the quantity of fluid that has passed through the metre.

Fig. 1, is a vertical section of the improved arrangement of water metre; fig. 2, is a plan view of the same; fig. 3, is a horizontal section; and fig. 4, is a cross section.—A, and B, are two cylinders, which may be cast separate, and placed together, or they may be cast in one piece. Into these cylinders are fitted the four pistons a^1, a^2, b^1, b^2, connected together in pairs by the rods c^1, c^2. Between the pair of pistons b^1, b^2,

* From Newton's Lond Journ., Jan., 1857.

is placed a valve D², similar in form of construction and general principle of action to an ordinary steam slide-valve. Between the pair of pistons a^1, a^2, is also placed a slide-valve D¹, differing only from the

Fig. 1.

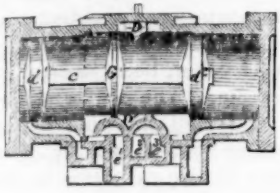
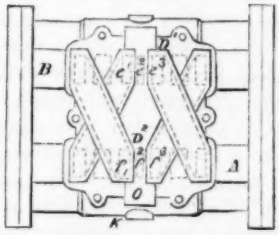


Fig. 2.



last-mentioned in having two cavities in its face instead of one. This difference causes it to admit and discharge the fluid in a direction exactly contrary to what the last-mentioned valve would if moving in the same way. The different directions given by the valves D¹, D², to the fluid, are shown by arrows. Three openings or ports appear under each valve; the ports e^1, e^2, e^3, being under valve D¹, and f^1, f^2, f^3, being under valve D². They correspond with the well known induction and eduction ports, over which an ordinary steam slide-valve is worked. The fluid to be measured is admitted under pressure to the space between the pistons through the openings K, making equal pressure upon the interior faces of them all. Let us suppose the pair of pistons a^1, a^2, to have just completed a stroke from right to left. The projection or disk G¹, on the piston-rod C¹, having been brought into contact with the

Fig. 3.

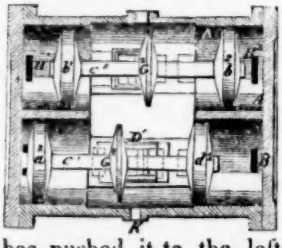
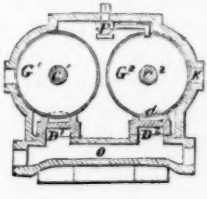


Fig. 4.



valve D¹, has pushed it to the left far enough to admit the fluid into the port e^1; but this port, instead of communicating with the end of the cylinder B, in which the pistons are moving, is carried across diagonally into the end of the cylinder A, (shown by the arrows in fig. 2,) which it enters at H¹, in fig. 3; at the same time the delivery or discharged fluid (shown by the arrow in fig. 1,) flows from the ports e^3, into e^2, and thence through the delivery passage O, from the cylinder A, through the opening H¹, fig. 3, in a diagonal passage indicated on fig. 2, by arrows. The pressure of the influent water having been thus established through the opening H¹, fig. 3, upon the piston b^1, and escape afforded for the fluid behind the piston b^2, through the opening H², this pair of pistons will move from left to right. When near the end of the stroke, the disk G², coming in contact with the valve

D², lying under it, will push such valve across the ports. Diagonal passages similar to those before explained, connect these ports to the ends of the cylinder B. On fluid being admitted into one end, and escape from the other being thus afforded from the cylinder B, the pair of pistons therein contained must return from left to right. On their way they in turn actuate the valve again for the cylinder A, and compel the pistons situated therein to make another stroke. Thus, by the mutual action upon the valves of each other, both pairs of pistons are made alternately and surely to reciprocate. The counter or register may be constructed in any convenient and well known way, and attached to a rod projecting through a stuffing-box, as at P, fig. 4.

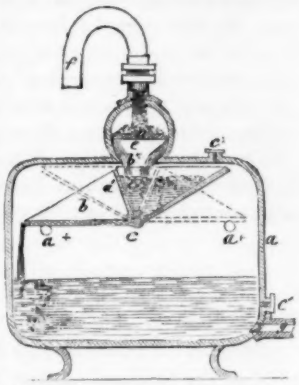
The patentee claims, "the employment of two cylinders in the construction of a metre for fluids, which may be designated as cylinders A, and B, with pistons fitted to work in the same, so arranged and combined with regard to each other as that the motion of the piston in cylinder A, shall, at the proper time, actuate the supply and delivery valve of the cylinder B, while, in like manner, the piston moving in cylinder B, shall actuate the supply and delivery valve belonging to cylinder A; thus mutually determining and regulating the flow of the fluid to and from each other, and producing a positive and direct motion, as herein fully set forth."

Specification of a Patent granted to RICHARD ARCHIBALD BROOMAN, *of Fleet-street, for improvements in apparatus for measuring liquids; which may also be employed as a motive power engine,—being a communication.*—[Dated 19th November, 1855.]

This invention relates to improvements in apparatus for measuring liquids under the pressure of the column, and which is also applicable as a motive power. The principle involved differs materially from the plans hitherto proposed for the purpose, and is distinguished from them by the fact that the measuring vessel, or (in case of motive power) the mechanism used to transmit the force of the water, is worked in compressed air, or some other elastic fluid.

The figure is a sectional elevation of the improved apparatus for measuring liquids. *a*, is an air and water-tight case containing the measuring vessel *b*, which is placed in the upper part of the case. This vessel is a shallow cup, having an inclined or trough-shaped bottom, and resting upon an axle *c*, placed where the two inclined planes meet at the centre. The cup is divided into two parts by a vertical partition *d*. Immediately over the axle *c*, is an aperture *b**, in the top of the case *a*, through which the water or other liquid enters. Above the opening is a second vessel *e*, called the "retarding vessel," partially divided by a plate *d**. *f*, is the supply pipe, which opens into the vessel *e*. The use of the retarding vessel is to break the force of the water entering, and cause it to fall into the measuring cup with as little momentum as possible: this may be accomplished by various means. When the apparatus is employed for motive power purposes, the "retarding" of the water is not required, and the vessel *e*, may be dispensed with.

g, is the delivery-pipe, furnished with a discharge-cock. The operation of the apparatus is as follows:—Supposing the case *a*, to be empty of water and to contain only air of the ordinary atmospheric pressure, the water is admitted through the pipe *f*, and falls into one side of the measuring vessel *b*; because, the axis being below the centre of gravity, it will always be tilted over to one side or the other, until arrested by one of the stops a^*, a^*, and the top of the partition *d*, will then be in such a position that the water can only flow into one side. As soon as sufficient water has entered to overcome the weight of the opposite half, the vessel will tilt over and discharge its contents,—the water then flowing into the compartment opposite, and the action so continuing. As a measure, it is of course only necessary to know how much water is required to overbalance the empty compartment. The discharges are registered by the vibrations of the measuring vessel acting upon any suitable train of clock work and indexes in any well-known manner. As the cock in the outlet pipe remains closed, the water accumulates in the case *a*, and the air therein becomes gradually compressed as the water rises until such compression becomes equivalent to the force due to the height of the column: water will then cease to enter; and it is intended that the measuring vessel be always in this compressed air space. On opening the cock to draw water, the pressure being thereby relieved, the air will expand, and of course the water will enter through the supply-pipe *f*, and act on the measuring cup, as before.



The methods adopted for maintaining the air space are thus stated: It is well known that, as the pressure on it increases, water can be made to absorb more air than it contained under the ordinary conditions of the atmosphere. In the conditions under which this apparatus operates, the air might also be absorbed and carried off by the delivery-pipe, in which case the measuring vessel would cease to work. Aqueduct water, however, carries along with it a quantity of air in bubbles, and the air, thus conveyed, will, it is believed, be sufficient to keep up the supply; but if found not to be the case, it is only necessary to empty the water out of the case *a*, and open an air cock, to obtain a new supply, as occasion may require. c^*, c^1, represent air vents intended for this purpose. On closing the pipes *f* and *g*, and opening the vents c^*, c^1, water will run out of the vent c^1, and air will enter at the vent c^*, until the case *a* is recharged. There are several other ways of effecting this, by self-working arrangements: for example, a small slide-valve may be attached over the aperture c^1, and the stop removed—the vibrations of the measuring vessel working it: thus a few drops of water might be discharged by the opening, and the space in the hollow of the valve, being replaced by air, the air would be carried within on the return movement.

To apply this invention as a motive power engine, some one of the various descriptions of water-wheels is substituted for the measuring cup. In this case the retarding vessel *e*, is not used, as the full momentum of the water will be required. It will be seen, that the power is obtained by the passage of the water through the condensed air medium; therefore it is still available for other purposes, as it will issue with undiminished pressure through the passage *g*.

The patentee claims, "the improvements in apparatus for measuring liquids and for motive power purposes, hereinbefore described, and represented in the drawings annexed."

Specification of a Patent granted to THOMAS TAYLORSON JOPLING, *of Bishop's Wearmouth, in the County of Durham, for an improved construction of water metre.*—[Dated 27th February, 1856.]*

The object of this invention is to simplify the construction of water metres, and to remedy the defects hitherto pertaining to reciprocating metres when employed for measuring water at a high pressure. To this end two measuring cylinders are employed, which are each provided with a working piston, the rods of which severally carry a slide-valve frame. Or, in lieu of the piston, a flexible diaphragm may be used. These cylinders are enclosed in a water-tight case, into which the liquid to be measured first flows before entering the cylinders, and a provision is thus made for the deposit of stones and other extraneous matters that enter with the liquid, instead of allowing them to flow into the measuring cylinders or chambers. These cylinders are so arranged, with respect to each other, that the ports of the one (for letting water into the cylinder at opposite sides of the piston alternately,) will be covered by a loose slide-valve, which is carried by a valve-frame attached to, and actuated by, the piston-rod of the other cylinder. The lead-off passages of the two cylinders all connect with a common discharge pipe; and as the apparatus is double-acting, a continuous discharge will take place. The action of the one piston is so dependent on the other, that all tendency to create shocks or produce sudden and unequal pressure will be avoided. On the frame of one of the slide-valves, teeth are formed for driving a toothed wheel connected with a counting apparatus, and the number of strokes made by the pistons is thus ascertained, and consequently the amount of liquid passed through the metre.

Fig. 1, is a sectional elevation of the improved metre; and fig. 2, is a sectional plan view, showing the arrangement of the inlet and outlet passages and valves. *a*, *a*, is a cast iron water-tight case, composed of two parts bolted together, and enclosing two cylinders or measuring chambers *b*, *b**. In these chambers work pistons *c*, *c**, the piston-rods of which are arranged parallel to each other, and severally carry, at their outer ends, a frame *d*, for supporting and operating the valves *e*, *e*, which govern the supply and discharge passages *f*, and *g*, of the cylinders *b*, *b**. The valve of the cylinder *b*, it will be seen, will be

* From Newton's Lond. Journ., January, 1857.

operated by the reciprocating motion of the piston-rod of the cylinder *b*. *h*, is the pipe for admitting water to the case *a*; and *i*, is a pipe connected to the cylinders *b*, and *b**, by their respective pipes *k*, and *k**: and intended to discharge the water from the metre as it is measured. When the valves are in the position as shown at fig. 2, the filling of the space [1], of the cylinder *b*, will have been just completed, and in that completion the piston will (through its rod and the frame which it carries) have shifted the valve of the cylinder *b**, and thereby have cut off the supply of water to the space [1], of that cylinder, and brought the other end [2], in communication with the outer case *a*. The end [2], will therefore now be filling—and when the filling is on the point of completion, the piston *c**, (by reason of the frame which its rod carries) will cause the valve of the cylinder *b*, to assume the position indicated by the dotted lines, fig. 2, and thereby cut off the supply from the space [1], and let on the water to the other end [2], of that cylinder. From this explanation it will be understood that the valve of the one cylinder is shifted just previously to the completion of the stroke of the piston of the other cylinder, and by the direct action of that piston communicated through the piston-rod and the frame which it carries. Each frame is fitted with turned-up or flanched ends, which act as tappets, and strike respectively the opposite ends of the valve, and cause it to open and cover the passages *f*, and *g*, alternately. For the purpose of keeping the valves *e*, close up to their seats, spiral springs *l*, *l*, are provided; which press lightly against the back of the valves. The valve frame of the cylinder *b**, is furnished at back with two teeth or chamfered ribs *m*, *m*; which during the reciprocating motion of the frame alternately take into the teeth of a wheel *n*, keyed to a shaft *o*, in connexion with any suitable counting apparatus, and thus cause the number of traverses made by the pistons to be marked on the counting apparatus, which number indicates the amount of liquid that has passed through the metre. The passages of the cylinder *b*, it will be seen, are very similar in their arrangement to those for admitting steam to a steam engine cylinder; but those of the cylinder *b**, are arranged so as to cross each other. Their course may be best traced in fig. 1, where the port, shown open, is that for admitting water to the end of the cylinder marked [2], (fig. 2,) and the closed port is that for admitting water to the space marked [1], (fig. 2,) of the cylinder *b**. The work-

fig 1

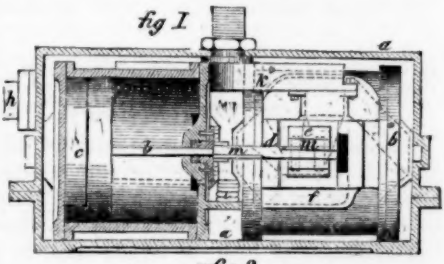
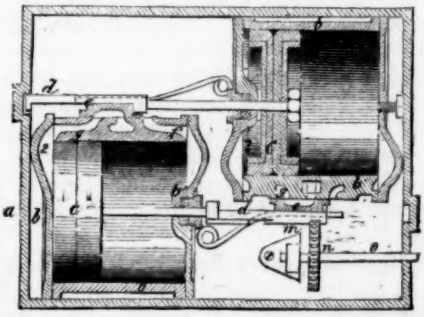


fig 2



ing of this metre, it will be understood, must be smooth or without jerk, as the pistons may be said to float in a body of water,—the pressure being equal, or nearly equal, on both sides of the pistons. The pressure of the water being sustained by the outer case, the internal parts of the metre may be made comparatively light, and there will be little liability of leakage. When diaphragms are applied in place of pistons, they are constructed in any well known and approved manner, and they are connected at their centre to the reciprocating rods which carry the valve frames.

The patentee claims,—"First, the general arrangement of the parts, as above described, whereby I am enabled to measure fluids under great pressure with great facility, and by the simultaneous action of a pair of pistons, or their equivalent, working in their respective cylinders, to discharge the same in a continuous stream from the metre. Secondly,—the use of a water-tight case, in which the measuring chambers are contained, for ensuring an equal pressure of the fluid to be measured on the interior and exterior of the measuring chambers, and permitting of the deposit of extraneous matters contained in the water outside the measuring chambers. Thirdly,—mounting the slide-valves in guide frames carried by the piston-rods of the measuring chambers."

---

*On the Employment of Ferrocyanide of Potassium for the removal of Rust-spots in White Linen.** By Prof. Runge.

The employment of ferrocyanide of potassium may often help us out of great difficulties in the case of rust-spots in linen. These do not always consist of common hydrated oxide of iron, but also frequently of oleate of iron, which can only be removed with difficulty, and with the assistance of heat, by oxalic acid, or the binoxalate of potash; and often not at all by sulphuric or muriatic acid, for these acids can only be applied cold and very dilute, as otherwise the linen suffers. From the high price of oxalic acid, therefore, a cheap means is wanting, when a great quantity of such iron moulds is to be destroyed. A case of this kind once occurred to the author, in which sulphate of iron had been used instead of potash, by which 300 napkins and other table linen all acquired a rusty yellow color, which, on being washed with soap, instead of disappearing, became darker; the sulphate of iron being decomposed by the soap, and oleate of iron precipitated upon the fibres.

Immersion even for several days in water acidulated with sulphuric and muriatic acids produced no effect, because the oleate of iron was not decomposed. It was here that the ferrocyanide of potassium did such excellent service. It was added in comparatively small quantity to the water, acidulated with sulphuric acid, and the linen was then moved about in the fluid. The linen became blue. When all the yellow had disappeared, and a clear blue had made its appearance, the linen was rinsed and treated with solution of carbonate of potash. Here the blue color again disappeared, and with it a great part of the yellow, which

*From the Lond. Chem. Gaz. No. 353.

only remained in spots. These were then very easily got rid of by dilute sulphuric acid alone.

The explanation of this process is easy. By the formation of Prussian blue, the oleic acid is separated from the oxide of iron. The carbonate of potash then brought into action combines with the oleic acid, decomposes the Prussian blue, and at the same time also dissolves the greater part of the oxide of iron, so that almost all the iron mould disappears from the stuff simultaneously with the Prussian blue. Caustic ley does not act in the same way; it certainly destroys the blue, but the rusty yellow remains, because it has not the same solvent action upon oxide of iron as carbonate of potash.—*Polyt. Centralbl.* 1857, p. 542.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, August 20, 1857.

Dr. B. H. Rand, President, pro tem., in the chair.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Letters were read from the Royal Cornwall Polytechnic Society, Falmouth, England, and The Kentucky Mechanics' Institute, Louisville, Kentucky.

Donations to the Library were received from the Statistical Society, and the Institute of Actuaries, London; The Smithsonian Institute, and the Superintendent of the U. S. Coast Survey, Washington City, D. C.; The North-western Virginia Railroad Company, and the Maryland Institute, Baltimore, Md.; The Richmond and Petersburg Railroad Company, Richmond, Virginia; The Mechanics' Institute of Tennessee, Nashville, Tennessee; Messrs. A. B. and E. Latta, Buck-eye Works, Cincinnati, Ohio; The Mercantile Library Association of the City of New York; The Trustees of the Free Public Library, New Bedford, Massachusetts; Judge S. Ross, Coudersport, Pennsylvania, John Warner, Esq., Pottsville, Pennsylvania, F. Watts, Esq., Carlisle, Pennsylvania, and the Pennsylvania Hospital: Philip Price, Esq., Robert H. Gratz, Esq., and Prof. John F. Frazer, Philadelphia,

Donations to the Cabinets of Models and Minerals from J. A. Roth, Esq.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement of the receipts and payments for the month of July was read.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Exhibitions reported that, not being able to find at the present time a building of sufficient dimensions to hold the Exhibition of American Manufactures, they recommend to the Institute to suspend the Exhibition for the present year; which, on motion, was done.

New candidates for membership in the Institute (6) were proposed, and the candidates (3) proposed at the last meeting were duly elected.

A specimen of Mr. Williams' Patent Nut for Axles, was shown by Mr. W. Jones, consisting of a nut having a recess cut in the interior, into which

a tongue, let into the screwed end of the axle, and hinged at the outer end, rises by the action of a spring when the nut is screwed home, and prevents the nut from unscrewing. When it is desired to remove the wheel, a small pin is inserted in a hole drilled through the body of the nut, into the recess and upon the tongue, pushing it out of the recess, and permitting the nut to be unscrewed.

Dr. Rand called the attention of the members to a recent important improvement in the chemical arts, made by Mr. Alfred Monnier, of Camden, New Jersey, a gentleman already well known to the members, by his improvements in the manufacture of sodium and aluminum. Mr. Monnier's patent is dated 11th August, 1857, and is for an "Improvement in the manufacture of sulphuric acid from the metallic sulphurets." It is more especially applicable to the native sulphurets of iron, copper, zinc, nickel, and cobalt, and consists in burning off *all* of the sulphur, leaving the metal in the state of oxide.

The process is substantially as follows:—the powdered sulphuret is mixed with a sufficient quantity—say twenty-five per cent.—of dry sulphate of soda, and the mixture made into blocks or balls. These are exposed to a low red heat; if in a furnace, the combustion when once begun, will continue unaided. All of the sulphur is disengaged as sulphurous acid, which is converted into sulphuric acid in the usual way; a small quantity of sulphuric acid is also given off, especially if there be some of the sulphate of the oxide of the metal mixed with its sulphuret.

The residue consists of sulphate of soda, and the oxide or oxides of the metals of which the sulphurets had been burned; these are separated by washing. The solution of sulphate of soda is evaporated to dryness, and thus the same amount of that salt may be used over and over again. The oxides are treated in various ways, according to their nature. Thus the mixture of the oxide of copper and sesquioxide of iron is treated by weak sulphuric acid, which dissolves the former, leaving the latter untouched. When the sesquioxide of iron and the oxide of nickel are mixed they are allowed to remain moist for a few days, when the latter becomes hydrated and soluble in acids, while the former is not changed. The oxide of iron, if in large quantity, may be reduced.

Dr. Rand exhibited specimens of the materials employed, and of the results of the process.

The advantages of the process over the ordinary roasting are readily seen. By using the sulphur so abundantly diffused over the surface of the earth in combination with metals, and which was formerly in great part lost, the price of sulphuric acid may be reduced. The acid may be cheaply made at distant localities, where the cost of transportation of sulphur, or of the acid itself, would be considerable. The acid employed in the metallurgical processes required by the ore, which frequently does not need to be concentrated, can be made on the spot at very low rates. The metals are obtained by a single operation in the manageable form of oxide.

The theory of the process is obscure, and, perhaps, complex. It may depend upon the oxidation of the sulphur by one equivalent of oxygen from the sulphuric acid of the sulphate of soda; which is thus reduced

to sulphite of soda; this sulphite regaining its oxygen from the atmosphere, and becoming again sulphate, as it is found in the residue. Mr. Monnier is engaged in a series of experiments on the nature of the reaction, which, when completed, will probably elucidate the theory.

Mr. Philip Boileau Jones stated, that in England the process named by Dr. Rand has been practised for some time, with the exception of the addition of sulphate of soda. The pyrites being burned raw, in kilns constructed peculiarly, having a small draft, and the ore in the kiln never being allowed to get above a dull red heat, and the sulphur being only slowly eliminated, the oxidation of the sulphur and ore is very nearly perfect, never leaving more than five per cent. of sulphur in the ore, and by this simple process, the whole depending on the regulation of the draft, the poorest ores of copper are rendered capable of being worked at a profit; the ores that he had worked upon not containing more than two or four per cent. of copper, and from thirty to fifty per cent. of sulphur, and the result of this roasting was a residue containing from three to seven per cent. of copper, and not more than three to five per cent of sulphur, and as nearly as possible the remainder of the sulphur is in the said chamber, as sulphurous acid.

Dr. Rand explained that the difference in the processes consisted in the fact that in one it was a mere utilization of the sulphurous acid obtained by ordinary roasting, which had long been done both in England and on the Continent; while in the other there was a complete and rapid combustion of *all* the sulphur, by the agency of the sulphate of soda, and the metal was obtained as oxide, *free from sulphur*.

Dr. Rand requests that the following note may be inserted in the Proceedings of the Meeting.

In the old process of burning pyrites for the manufacture of sulphuric acid, years of experience have shown that it requires three and a half tons of pyrites to be equivalent to one ton of sulphur; that the quantity of nitrate of soda used is at least sixty-five pounds per ton of pyrites: that the sulphuric acid chamber using sulphur will last sixteen or eighteen years, while a similar chamber burning pyrites will last but five or six years. The use of pyrites requires a comparatively much larger chamber than that of sulphur. The use of powdered pyrites gives somewhat better results, but the destruction of the chambers, and the contamination of the acid have caused the attempts in this country to be abandoned.

Mr. Monnier states that with his process the amount of pyrites used is but one-half of that required by the old method, while the quantity of nitrate of soda is less, and will be even less than when sulphur is used, provided too high a temperature be not attained in the burning. This is due to the fact that some sulphate of iron will be formed, and dissolved with the sulphate of soda, and being used again will give some sulphuric acid. He claims that the chamber will last as long, and require to be of the same size as for the burning of sulphur, since only sulphurous acid, with some sulphuric pass into it. The combustion of the pyrites by Mr. Monnier's method, is nearly as rapid as that of sulphur, and as the blocks retain their form, they burn without allowing their solid material to pass over into the chamber.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Gordon's Card Printing Press.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination Gordon's Patent Card Printing Press,

REPORT:—That they have examined the press made by Mr. Gordon, now in operation in the printing-office of Mr. Howell Evans of this city. This press, arranged for printing, cutting, and counting cards automatically, has most of its individual parts in common with other existing machines, it being the *combination* which is claimed principally by the patentee.

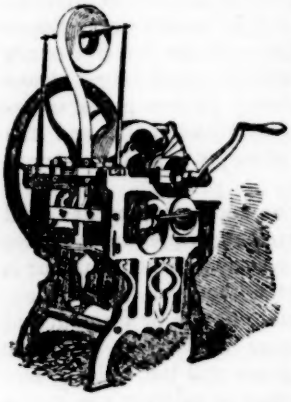
The press consists essentially of a fixed inking or distributing cylinder, of which the movable platen containing the type forms part of the periphery, two sets of inking rollers, which are attached to the extremities of a diametric arm revolving on the axis of the large cylinder, supplying the ink to the type.

The platen containing the type, moves horizontally and in a direction radial to the large cylinder, and presses the card to be printed against a fixed adjustable tympan, making two strokes to each revolution of the inking rollers.

The motion of the platen is said by the inventor to be, and as far as the Committee can discover, is, peculiar to this machine; it being moved by an ordinary crank on a shaft concentric with the large cylinder, instead of the somewhat complicated toggle-joint which has been used in the presses.

This arrangement gives it its capability of running at the great speed which it attains.

The cards are fed to the press in a long strip, wound off of a reel as in a Morse telegraph register, and after passing the platen and receiving the impression, are cut off by a knife working horizontally below the platen, and fall into a basket placed for their reception.



The cards or rather the impressions are counted by an ordinary engine counter, which, in the opinion of the Committee, might be improved both in itself and in the manner of its connexion with the machine.

At the time that it was examined by the Committee, it was on ordinary office work, and was printing from 4800 to 5100 cards per hour, according to the varying speed of the engine below. It is asserted that 10,000 cards can be printed per hour; an assertion which the Committee see no reason to doubt.

The impressions are exceeding perfect and uniform, and the work evidently of the best character.

Altogether the Committee consider the press an exceedingly perfect

machine, and express their high approbation of the great beauty of its mechanical arrangements, particularly the simplification of the *impressing* apparatus by the substitution of the crank for the toggle-joint.

It may be well to state that the greatest number of cards hitherto printed on the best constructed *hand* presses is about 1700 per hour.

By order of the Committee,

Philadelphia, July 9th, 1857. WILLIAM HAMILTON, *Actuary.*

Report on J. H. Cooper's Hand Printing Machine.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Hand Printing Press, Invented by Mr. JOHN H. COOPER, of Philadelphia, Penna.,

REPORT:—That the instrument as exhibited in the model submitted and described in the accompanying paper, consists essentially in a horizontal wheel, upon whose circumference the type are mounted, and whose axle is capable of a sliding motion in a vertical direction independent of the wheel. The rotation of the axle is effected by a handle attached to it by an intermediate horizontal axis, around which the handle is capable of moving in a vertical plane; but this motion is limited by a point on the projection, attached and opposite to the handle, which when the handle is depressed, rises under the upper rim of the casting, and affords a fulcrum, so that any farther pressure upon the handle will depress the axle of the type-wheel. The letters of the alphabet, and other typographical signs, are arranged around the upper rim, so that when the handle is turned to any one of them, the corresponding type is opposite to the printing apparatus, and the under surface of the rim is drilled with conical holes, into which the projection of the handle fits, so that the type shall be brought exactly opposite to the press, although the index should not be brought exactly to the middle of the corresponding letter. The printing is accomplished as follows:—The axle of the type-wheel, when it is depressed, operates upon the end of a lever which turns a horizontal axis, to which is attached by arms at its ends a horizontal bar, so that as the axis is turned, the bar is rocked forward towards the type-wheel, and the hammer or press being fixed upon this bar, the paper which is carried by properly adjusted rollers, is by it pressed against the type and takes the impression, the type being inked by rollers so placed as to press against their surface at every motion of the type-wheel. Another arm upon the horizontal axis carries a click which falls into the teeth of a rachet wheel, moving this wheel forward one tooth at each depression of the type-wheel axle. This wheel carries a cord attached to a stud on the frame carrying the paper rollers, so that whenever the axle of the type-wheel is depressed and a letter printed, the paper is moved forward sufficiently to space the next letter properly. The various parts are controlled and returned by appropriate springs.

In the opinion of the Committee the apparatus, as arranged by Mr. Cooper, is ingenious, and deserving of praise. In the machine shown to the Committee, the type-wheel carries only capital letters, and in order to make the apparatus practically useful, except in a very limited degree, it will be necessary either to enlarge the wheel to an inconvenient degree, or to add to it a second type-wheel, with adjustments by which the paper may be brought opposite to either of them at pleasure. In the present machine, too, when the line of printing is finished, the frame must be slid back, and the paper advanced for the new line by hand; but it seems to the Committee that it would not be difficult to the ingenious inventor to perform these operations by the machinery. In practice, too, some modifications would be necessary to render the machine more stable and certain in its action than the one exhibited, which is understood to be only the first experimental model.

The Committee therefore deem the machine of Mr. Cooper worthy of commendation for its ingenuity.

By order of the Committee,

Philadelphia, July 9th, 1857. WILLIAM HAMILTON, *Actuary.*

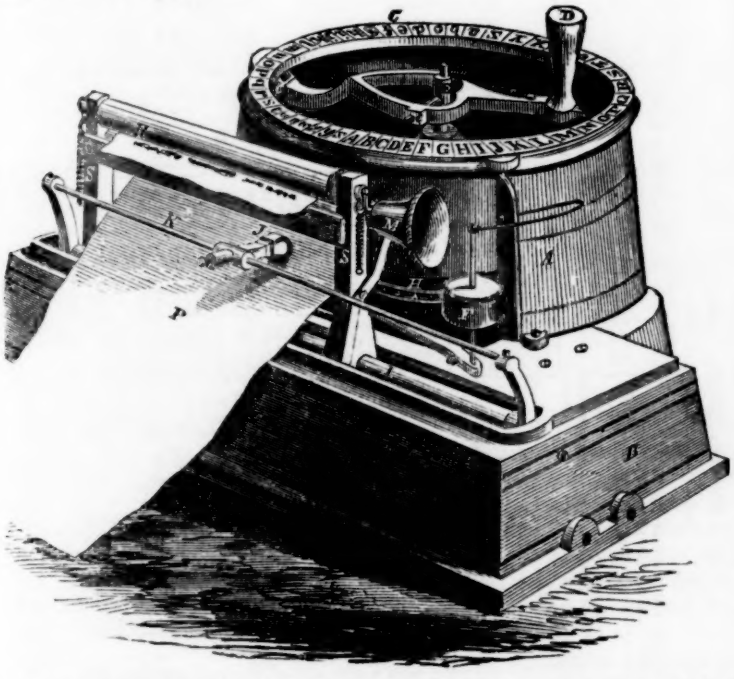
Description by the Inventor.

The type-wheel H, revolves on anti-friction rollers on the sliding axis E, within the case A, and any type desired is brought to the printing place by the hand lever and handle D, pivoted on a cross-pin near the top of E; the pointed end of lever under handle D, indicating the letter desired to be printed. The opposite end of lever has a conical point, which strikes into a countersink on under side of letter circle C, which adjusts the type-wheel *exactly* to the proper place for printing. The paper is stretched between three wires at bottom of frame S S, and rolls R, *near* but *not touching* the type. I is a rocking axis in the middle of which a lever is secured, projecting to the sliding axis E, which rests on its end. On the extremities of axis I are two upward curved levers, connected at their ends by a stout wire K, on its middle and right opposite the type to be printed, a presser bar, faced with a cushion J, is secured:—now it is evident that if the sliding axis E be depressed, the presser bar J will approach the paper and press it against the type and receive an impression; removing the pressure from E, a spring inside of base B, forces lever upwards and J backwards from paper, at the same time actuating mechanism in base B not seen, which draws carriage and paper along for next letter. When the line is printed, the paper frame is adjusted for a new line by turning hand wheel M one "notch," which moves rolls R, and draws the paper through, and pushing frame back to its place of starting.—The type receives ink from two rollers, one F, on near side, and the other on opposite side of machine.

Operation.—To insert the paper: remove the brass wire in the paper frame, by pushing it against the spiral spring on one end of it; introduce one end of paper downwards, between presser bar J and type-wheel and in front of wires—insert the other end between rolls R, and turn them a little to fasten the paper, then put the brass wire in its place again, and by turning rolls R a little more, stretch the paper, allowing the click to rest in its appropriated notch in hand wheel M.

Push the frame s s back to its starting place.

To ink the rollers properly—take a portion of good printer's ink about the size of a grain of wheat, place it on a smooth, clean surface, like tin or plate, remove rollers from machine, and like the operation of rolling pie-dough, completely cover the surface of rolls with the *thinnest film* of ink possible; continue the rolling until the ink to all appearances has disappeared, using no more ink than the quantity specified.—Economy is, *emphatically*, success in this case, as too much ink on rolls will clog the types and deface the paper. It *must* be understood that no good printing can be done on *any* machine when the inking apparatus is not in proper working order.



After replacing the ink rollers, and noticing that the tension of their springs is just sufficient to press them against the types with the slightest touch possible; the machine is then ready for printing.

Take hold of handle D, and move it around until the pointer under it indicates the letter desired, then with a smart and decided, yet free motion of the hand, press the handle downwards, until a "click" is heard, and the impression is made; assist the handle upwards until another "click" is heard, then move to next desired letter and produce its impression, and so on. A little practice will enable any one to print as rapidly as good ordinary writing is done.

To clean the types, dip a clean, soft tooth brush in alcohol or turpentine, and while revolving the type wheel hold it gently against the face of the types.